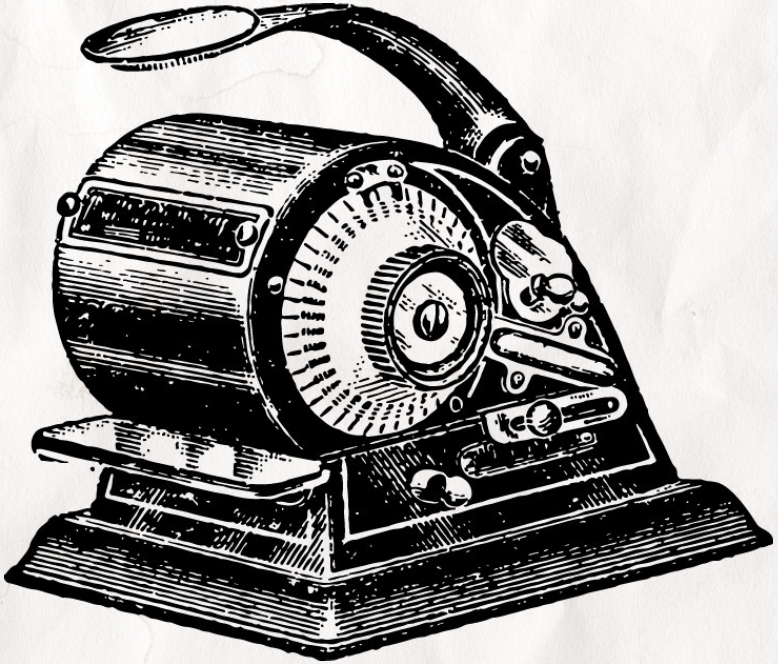
# ENGAGING THE DATA MOMENT



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## Special Issue: Engaging the Data Moment

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# Engaging the data moment: an introduction

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## Abstract

All of the contributions to this special issue are occupied with how to *engage data otherwise*. This *otherwise* indexes the rich variety of approaches to data beyond what we are currently witnessing. Whether through the development of politically and ethically relevant forms of data experiments, or the construction of alternative visions of the much-critiqued data infrastructures of powerful platform providers, all the articles reflect upon how we––as scholars and citizens––can live and work with data in ways amenable to diverse, critical, and ethical forms of social existence. This introduction intervenes in this debate in its own particular way, principally by considering what it means to characterise the contemporary as a *data moment*. The term data moment, we argue, works as a conceptual device calling for more ethical-political engagement with data practices. At the same time, it also retains a temporal inflection. Moments, we claim, are not sequential steps in a linear process, but are themselves productive of, and products of, temporal orders. Moments are also saturated in affect, we argue, and it is such affects that contribute to how particular forms of meaning emerge with/as data. By embracing the compelling empirical, theoretical and ethical challenges of this *data moment* our ambition with this special issue is to make a modest contribution to how scholars can engage data in the present, while also shaping a future where data are treated critically, ethically, and reflexively.

**Keywords**: data moment, temporality, aesthetics, narration, qualitative-quantitative, experimental



## Engaging data otherwise

It has become commonplace to suggest that our contemporary moment is ever increasingly characterized by, and through, data. Imaginaries of data's power and potential run wild as what data are, can become, or attain, are conceived of in near limitless terms; the new oil, a new global currency, the new vehicle of growth, even.[1] From self-tracking movements, to newly emerging forms of economics (bitcoin and blockchain economies), to sensing-based environments (the internet of things), to the Janus-faced potentials of data analytics, optimism around the potentials of data to transform people, organizations, and societies continues to proliferate.

While the litany of data related controversies grows almost daily, an unease around how we––citizens, practitioners, and scholars––can engage *otherwise* with data also grows apace. By this we mean that questions are amassing about how we can live and work with data in ways amenable to diverse, critical, and ethical forms of social existence. Our media platforms are awash with the appearance of large technology companies performing mea culpas before democratically elected legislatures around the world, as CEOs––formerly the shiny captains of a new and benevolent industry type––now seek to refute, assure, or assuage various publics on any number of data related issues. These performances have predominantly focused on data privacy and security, but have, more recently, begun addressing not just *if* some of these corporations pose a threat to democracy (think Cambridge Analytica) and public safety (think Covid-19 misinformation) but *how* we can begin to remedy such threats. At the same time, a wave of former tech-purveyors turned reformist-proselytizers entreat us to be wary of the promises of datafied technologies, and to demand more of them for the collective good. Recent instantiations of this in a Danish context

[1] See https://www.forbes.com/sites/forbestechcouncil/2019/11/15/data-is-the-new-oil-and-thats-a-good-thing/ and https://www.weforum.org/agenda/2015/08/is-data-the-new-currency/ and https://www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data

are the Copenhagen Catalog and the Tech Pledge. The former is a list of one hundred and fifty principles for 'new directions in tech,' originally conceived and designed in a distinctively manifesto-like genre in 2018 by a group of participants at the annual TechFestival in Copenhagen.[2] The latter––formulated in similar terms––is a promissory document whereby signatories 'commit' to act in more ethically inclined ways regarding the future development of tech.[3]

At the same time that concerns around data practices are gaining more traction through public hearings and interventions––even from within the tech industry––the rhetoric of becoming 'data-driven' continues to colonise the organizational thinking of both public and private institutions. This does not, of course, happen without resistance. Translating the hype and hopes of data into organisational practice never runs smoothly and such efforts may even be actively disrupted, or ignored, by actors in the midst of everyday constraints. Nevertheless, this 'seductive imagery'(Kreiner 1992) continues to flourish. Academic literature that engages 'data-drivenness' as an extant phenomenon comes in multiple stripes, but predominant among them are accounts designed to legitimise the hype inflated optimism associated with the powers of digital data.[4] At the same time, there are also accounts that critically engage such positions, while also reflecting upon, and experimenting with, the modes and forms of their own interventions. It is to this latter category that this special issue aims to contribute.

*Engaging the data moment* is a special issue that arose from the biennial meeting of the 2018 Danish Association for Science and Technology Studies (DASTS). The collection reflects not only a diverse range of institutions, but also addresses central themes and perspectives from the fields of STS and Data Studies. Our hope is that it will make a modest contribution to how we, as scholars and citizens, can engage data in

[2] The catalogue is a growing document which is contributed to each year at the tech festival.The Copenhagen Catalogue https://www.copenhagencatalog.org/

[3] The Tech Pledge https://www.techpledge.org/

[4] The majority of this literature comes from within business, organisational, and management related fields.



the present while also shaping a future where data is treated critically, ethically, and reflexively.

## A data moment?

What we have indicated thus far is the growing schism between the cry for public accountability and transformation of data practices, and the increasingly datafied practices of public and private organizations. In this section, we reflect upon our own intervention into this debate and consider what it means to characterise these ongoing developments as a *data moment*. The term moment has a long history of use in the social sciences. One memorable example is *Anthropology as Cultural Critique: An Experimental Moment in the Human Sciences* (Marcus and Fischer 1999). The central thesis of this book is that the mid-1980s "crisis of representation" resulted from an impoverished social theory that was being outflanked and outpaced by world events. The challenge for anthropology, the authors claimed, was to design ethnographic work that investigated and exposed what established theory had missed––in this case feminist, race, and postcolonial perspectives (Fortun 2012). This perceived 'lack' was the driving force behind the call for such a *moment* to be "experimental." However, while the term moment worked as a device to bind anthropology's *engagement* with the *experimental*, the concept remained unexplored and underarticulated in its own right.

Beyond this sense of the term - as a conceptual device calling for engagement - *moment* has a specific temporal inflection. While it doesn't quite designate *right now*, it retains a sense of an extended now, although what this extension is, is unclear. At the same time, the term elicits an aesthetic quality or affectation. We have moments in our lives that we deem significant, yet whose quality is difficult to articulate, elusive even. But such moments are no less affective or memorable because of this. They can be full of possibility and promise. They can be fleeting or extensive. But they can also, on the contrary, be laden with trepidation. Think about, for example, when someone asks to speak with you 'for a moment'. So, we could say that moments are saturated in significance, but of indefinite duration. Henri Bergson conceptualises this term, *duration*, as a way of thinking about a non-linear form of temporality that holds onto such an aesthetic quality. For Bergson, durations are; "convergences of different temporalities within one rhythmic configuration" (Bergson cited in Nielsen 2011: 399). While we do not claim commensurability between *moment* and *duration*, there are qualities of Bergson's use of the term that illuminate what we mean by moment. Firstly, as with duration, the temporal configuration of moment cannot be rendered through more classic tropes such as linearity or succession. Moments, we claim, are not sequential steps in a linear process, but are themselves productive of, and products of, temporal orders. Secondly, there is an aesthetic quality to duration that resonates with moment. Moments, we suggest, are saturated in affect, and it is such affects that contribute to how particular forms of meaning emerge with/as data.

The productivity of bringing the term *moment* together with data is that it pushes us to think about data as having both temporal and aesthetic forms: as being productive of temporal orders, while retaining a particular affect (or meaning) that impacts people and organisations in ways that are not always easy to account for.[5] A question, perhaps, of contemplating the meaningful - and multiple - *whens* of data rather than the more belaboured *what*. So, while there are already various ways to see data as temporal phenomena - for example, data could be considered temporal given their production at specific times and places - it is more interesting, we suggest, to hold onto a sense of data as tools for enacting temporal orders in affective ways. What we want to underline here is how the rendering and articulation of these temporal orders - traditionally conceived of as pasts and futures - are important to the various claims that are made on behalf of data. Characterizing the contemporary as a *data momen*t - a duration of significance - signals more than an epoch of technological governance which is dependent upon, or dedicated to, progressivist and solutionist imaginaries of

[5] For example, think of the various discussions around data being 'creepy' or 'haunted' or the use of other such tropes.



data.[6] It is a way of signalling that the social, political, and ethical data dilemmas we find ourselves enmeshed in, are saturated with claims, contestations, and implications that converge through particular modalities of articulating pasts and futures.

Let us lay out two of the various ways this special issue approaches these questions. First, much of the temporal thrust of data pertain to their *future proclivities*. Here, the hopes, aspirations, and agencies that are assigned to data - what we with others could call data imaginaries (Beer 2018, Ruppert 2018, Tupasela, Snell et al. 2020) or data promises (Hoeyer 2019) (Hoeyer 2020) - are pregnant with possibility. Oftentimes these imaginaries invoke ideas of societal transformation, holding out the potential to resolve grand tensions and conflicts. Examples range from the promise of more data-driven climate solutions, to leaps in medical developments via the use of personalised data, or even the resolution of long-standing social inequities through more aggressive public sector data interventions with citizens (O'Neil 2016, Redden 2018). Such imaginaries are of an anticipatory, promissory nature, and work to form our collective futures through the envisioning of various possible datafied scenarios. . This performativity can be understood in two senses. The first is the more ordinary way in which anticipatory action works, as the hype and speculation surrounding what data might potentially accomplish in the future inflect, and are productive of, the present. So, future modalities are constitutive of present action.[7] The second is the manner through which prediction, and more specifically predictive data analytics, has become a mode of action and governance that is expressly articulated as part of what digital data can do. So, it is not just the rhetoric of future possibilities that partially constitute how

[6] We would like to thank one of the reviewers for bringing our attention to this latter point.

[7] Anticipatory action is best exemplified through two classic examples. The first, and more modest, concerns how, for example, in consulting the weather forecast, we might decide to bring an umbrella to work. Here, the anticipation of rain impinges on present action. Another is how, for example, speculation about a run on a bank can create a sense of panic that activates customers to withdraw their money, which in turn makes the bank insolvent. Here, the anticipation of a particular future brings about that very future. A less modest form of anticipation is at work here, one could argue.

we operate in the present, but the articulation of a claim - which is at the same time a desire - to be able to know what the future can bring, and which can intervene in that very future to particular effect. STS scholars have, for some time, studied the effects of predictions and expectations (Brown and Michael 2003, Brown and Rappert 2017) in particular prediction based practices such as modelling and simulations. Still, the predictive capacities invoked on behalf of digital data develop these logics in more extensive ways. While such logics are not new in markets, and industry more generally, we can now see such predictive claims being made, and set-in motion, in what formerly might have been called welfare arenas: health, education, social services, child protection, policing, court decisions, and so on.

Second, much of the discussion as to what does and does not constitute the 'newness' or 'bigness' of contemporary data is anchored in specific renderings of the past. Whether 'big data' is *conjunctive* or *disjunctive* with the past mostly depends upon which analytical histories and trajectories are invoked. A focus on the history of statistics and the production of large numbers (Desrosières 2002), or their mobilization within census making, points out how such practices are part of the "science of the state;" not only practices carried out by the state, but also part of what and how the state is constituted (see Birk and Elmholdt this issue). In such accounts, contemporary data practices build upon, borrow from, and otherwise scale up practices that have been ongoing since the early twentieth century (Beer 2016). Other scholars are less reluctant to claim a sense of uniqueness for contemporary data practices and justify such a stance through the putatively superior speed and scale of digital technologies (Kitchin 2014). Of course, identifying how digital data both continue and depart from historical modes and standards is where STS scholarship can be most insightful. So, while it is almost trite to suggest that the past is embedded in present data practices, the articulation of particular pasts - and the claims that they afford - help to constitute the present in ways that are entirely open to contestation. Let us take the claim of uniqueness - commonly made by the data analytics industry and - as one example. The question is not necessarily whether the data practices of today are unique as such, but how claims to uniqueness are constituted, and instantiated, through modes of converging specific futures and pasts.



## Data and Narration

Our engagement builds upon and works up against scholarship at the intersection of Science and Technology Studies (STS) and Critical Data Studies (CDS). What has emerged here has been a much-needed antidote to an overly-technicalised rendering of data's role in society. In a recent book, Yanni Alexander Loukissas (2019) disavows the central axioms of more dogmatic versions of data. Data are not, he asserts, *universal*: each disciplinary community has its own techniques for deciding what constitutes data, and this is, of course, extremely variable. They are not *singular*: they are aggregations whose articulation as singular verbs reveal a particular desire towards erasure. Data are *never big*: the ideology of big tends to fetishize collection and hoarding, and deflect attention away from data's origins, ethics, and complexities. They are never just *rhetorical*: they contain more than the power to persuasively represent the world; they actively shape it. These negative postulates are now common currency within STS and CDS and the ongoing impulse of work at this intersection continues to be towards asserting the infrastructural, or assemblage, quality of data, as well as their multiple configurations within various institutional and organizational contexts (Iliadis and Russo 2016). What data is, is always an empirically situated question.

While the first wave of data critique was, in part, triggered by Chris Anderson's now infamous claim of the 'end of theory' (Anderson 2008), the debates that followed have tended to somewhat over-emphasise the distinctions between quantitative and qualitative data practices. Tricia Wang's neologism *thick data* (2013) - itself a mobilization of Clifford Geertz's prominent ethnographic metaphor - became a clarion call for the need to do something qualitative with 'big data'. Since the publication of this text, there has been a wave of similar cries advocating for more qualitative approaches to data studies (Boyd and Crawford 2012, Gitelman 2013, Pink, Lupton et al. 2016, Dourish 2017, Ruppert, Isin et al. 2017). This is something we support, up to a point. And that point is one at which the distinction between quantitative and qualitative itself becomes a blockage on more creative, experimental approaches to studying, working with, and intervening in, data worlds. While there have been, and continue to be, many interesting methodological efforts to reconfigure the nature of this distinction (Rogers 2013, Blok and Pedersen 2014, Marres and Gerlitz 2016), texts that continue to overly reify it, still have significant traction in STS and cognate disciplines. One recent example is Sally Merry's *The Seduction of Quantification* (2016). While Merry's assertion that the application of quantitative measures - particularly towards those living in specifically vulnerable circumstances - can amount to a form of violence is well taken, this is only one part of a more complex story about numbers––as a form of data. As Danholt et al point out in this issue, STS has a long history of analysing the interstices of sclerotic divides, emphasizing the translations that such divides are ultimately products of. Numbers and stories - as placeholders for quantitative and qualitative approaches - are articulations of particular practices in particular settings (more on this below). Both are curated cut-off points of chains of translations that have a host of embedded, value-laden, concerns: be they political, socio-economic, or ethical. Where and how this cut is made very much depends upon what questions are asked, in relation to which problems, and for what purposes.

In this regard, a particularly noteworthy collection is *Raw Data is an Oxymoron* (Gitelman 2013), a book that has made a significant contribution to the STS landscape of data studies. While clearly signalling the need to reflexively critique, and push beyond, the more prevalent technicalised renderings of data, this book also subtlety articulates some of the precepts that undergird the quali-quant division. A key point in this regard is the suggestion that even thinking of something as *data* - and here the working understanding of data is those which can evidence something - requires imaginative and symbolic acts.



Constituting something as data is itself, therefore, a story act, or act of narration. This point, amongst others, is a call for us to be more attentive to the grounds upon which we make such distinctions in the first place. While there is much interesting STS work that follows on in this spirit, we would like to draw attention to two particular examples.

Dourish and Cruz (2018) take up the challenge of thinking through the various ways that data and narration interweave. Their specific focus is the many narrative acts at work within data driven analysis. What we learn from the text's rich examples is the various modes through which data and narration live within and alongside one another, and how the production of one can depend upon, or trigger, the production of the other. Not only are there many *narratives embedded within data* - how data were made and came to be - there is also much *data in narrative accounts*, as data are used as devices to help putatively qualitative scholars generalise, qualify, compare, and analogise. One could further add to this observation. Narratives also work *as data*, as they become evidence of something: ethnographic data, for example. In sum, the relationship between quantitative and qualitative data is complex, variable, and in some cases, interdependent.

In a paper describing a home-built energy monitor experiment, Hannah Knox (Dányi, Maguire et al. 2020) also points towards particularly productive moments when the data-narration boundary becomes blurred. In observing how participants of the experiment struggled to make sense of the numerical data shown on their energy monitors, Knox argues that data is good to think with, not because it explains as such, but precisely because it oftentimes does not explain in ways people find sufficient. In this regard, "data traces" open up a cascade of relations and are productive of new forms of description.

What we find encouraging from these texts is how - through insightful ethnographic engagement with data practices - they work against the grain of perceived wisdom around quali-quant distinctions. They do not conceive them as oppositional poles with inherent characteristics, neither do they dismiss them, nor do they inflate one over the other. Instead, we get a sense of interplay and partial connectedness

(Strathern 2004). What this helps us to see is that, while on the one hand the reified contrast between quantitative and qualitative data tends to be, for the most part, unhelpful, serving to produce more rigid boundaries in approaches to, and studies of, data. On the other, the drive to rethink the distinction opens up productive spaces for scholars to actively experiment with the work that goes on in the interstices of broad categories, categories that have generally served as placeholders for more complex traffic and exchanges. Such experimentation is, we suggest, also an important part of what constitutes this *data moment.* This is analogous to the experimentalism at the heart of the "experimental moment in the human sciences" where scholars designed anthropological questions and research programs in order to push contemporary theory beyond its myopic limits. However, unlike the moment of cultural critique in the mid-1980s, what we are attempting to engage with here is more than the desire to experimentally upgrade our theoretical armature to reflect an ever-changing world. We are, at the same time, leery of the various forms of experiment that are being unleashed on an increasingly agitated citizenry. Such agitation with the current state of affairs comes in multiple guises. Whether it be from the effects of ethically contentious practices such as predictive policing, or 'interventions' into the lives of vulnerable citizens, or the even more common place, but no less insidious, forms of data mining, extraction, and commodification (Zuboff 2019). Experimentalism, in this sense, is something to be treated ambivalently.

At the start of this introduction, we suggested that we want to *engage data otherwise,* mainly by thinking about how we can live and work with data in ways amenable to diverse, critical, and ethical forms of social existence. This *otherwise* suggests that there are a rich variety of ways to engage data beyond what we are currently witnessing. Whether through the development of politically relevant - and ethical - forms of data experiments, or the construction of alternative visions of the much-critiqued data infrastructures of powerful platform providers, or the generation of insights into the various affective registers that are embedded in this moment, such as anxiety, uncertainty, and trepidation, amongst others. At the same time, we are acutely aware that the data engagements of the vast majority are less about experimenting and more about working with everyday commercial and organisational issues and practices. Such practices, while possibly mundane, have nonetheless been central to the administration and governance of public and private sector work for decades, if not longer. Speaking of a *data moment* thus runs the risk of exoticizing matters to those who "simply" live and work within current data regimes as they attempt to make sense of data under the constraints of everyday work practices and expectations. At the same time, there is also a risk that mobilizing the term in the way we have could contribute to its preponderance in certain worlds, worlds that we want to set under scrutiny in this special issue. Our sense, however, is that our contributors do enough work to allay that fear, while, at the same time, embracing the compelling empirical, theoretical and ethical challenges of this *data moment*.

The diversity of articles in this special issue all resonate with the issues generated in what we characterized above as a *data moment.* Additionally, they are clustered around three further themes: *data experiments and interventions, data governance,* and *data concepts and approaches*. Four out of the ten contributions engage with, in some shape or form, various ways of thinking about, and practicing ***experiments*** in, on, and with, data. Although each article does this in its own particular way, what the articles share is a concern with *how* we experiment in politically relevant and ethically informed ways. By working through the dilemmas and complexities of their respective empirical sites, this section gives us rich, critically reflexive accounts of experimental data practices.

As an experiment in collaboration, **Mannov, Oberborbeck Andersen** and **Hojer Bruun** give a first-hand account of a Danish cryptographic research project involving mathematicians, anthropologists, and engineers. Analysing how 'secret sharing' is enacted in various settings, the authors pursue a socio-critical interventionalist approach that advocates for the development of "cryptographic techniques for social good". This article - while resonating with more traditional takes on forms of public engagement - is particularly concerned with the politics and ethics of experimenting with, and intervening in, the *data moment* beyond traditional disciplinary boundaries.

**Munk and Olesen's** article describes the dilemmas they experienced as digital methods scholars engaged in an effort to gather a large body of data from a soon-to-be-closed API that harvests data from Facebook. This is partially an experiment in the quandaries of re-tooling a post-demographic machine like Facebook. At the same time the piece is, what one might tentatively call, an experiment in 'salvage' digital ethnography. While its similarity to the more nineteenth century analogue lies only in its attempt to capture and catalogue a particular cultural archive prior to its disappearance, it's clear difference resides in its attempt to critically reflect on the variety of problems posed by this effort.

**Elgaard Jensen's** contribution is also a first-hand account of working across disciplines. However, in this case the author uses a series of digital methods collaborations between Danish and international researchers as a way to reflect upon a range of challenges within Digital STS today. In particular, the paper analyses how such collaborations raise questions about the promises that participatory forms of Digital STS can deliver on. Even more centrally, perhaps, the paper examines how this sub-field - with a particular focus on its digital instruments and data practices - can develop accounts that live up to the theoretical demands of a post-ANT sensitivity. This paper, then, is an experiment in theory, as the author reflects upon some of the theoretical choices, consequences, and opportunities that arise when using digital methods to address some of the shared inter-disciplinary problems being posed in this data moment.

The contribution from **Blok** is both a 'meta-experimental' reflection, and a challenge to the scholarly communities involved in social research based on digital data. The question posed by Blok asks how we can be more precise in our rendering and deployment of experimental registers. In doing so, Blok pushes us to specify what we mean when we say that our research is experimental; is this a conceptual, thematic, political, or epistemological claim? Concerned that our current practices are in danger of losing their moorings from more meaningful, dare we say disciplined, uses of terms such as experiment and intervention, the author draws upon the work of John Dewey as a source of inspiration for rethinking digital STS-as-experiment. Such a call for a form of meta-experimentalism is one that engages with our research design, practices, and consequences, and that pushes us to more specifically consider the felicity conditions of our epistemologies.

The next cluster of papers revolves around questions of ***data governance***. Here the authors share a concern with the politics of data and their impact on either state-citizen or market-citizen relations. Each paper focuses on a particular datafied technology (data registers, smart meters, radiation monitors) that in some shape or form reconfigures these relationships, mostly to deleterious effects.

The paper by **Birk and Elmholdt** brings to light the predominant role of data in urban governance. It analyses how various forms of data - personal number registers, census data, unemployment statistics and so on - are central to the production of a politically controversial 'ghetto list' in Denmark. Data practices, and their politics, the authors suggest, have many entwined and performative effects. In this regard, the authors argue that it is important to consider the historical, intimate, and controversial co-production of data practices with the people, groups, and territories that the state aims to govern. For these authors, the *data moment* is paradoxically both a break with, and a continuation of, former state enumeration and categorization practices.

The paper from **Jhagroe** analyses the novel energy governance strategies that are deployed in the surveillance and management of energy grids, markets, and consumers. The paper takes its point of departure in the empirical context of a Dutch-Belgian pilot project that has designed and tested the energy management of a smart home. Analytically, the paper provides a detailed account of the techno-politics of these datafied technologies by inviting us on an energy-data journey that highlights the visions and (perverse) effects of so-called "data driven management".

**Tam's** paper brings us to a small prefecture in Fukushima, Japan in the wake of the 2011 nuclear accident. This ethnographic story recounts how data from particular radiation technologies become the means through which the state attempts to make itself, and the effects of the nuclear disaster, legible to citizens. The paper also narrates moments of data resistance as citizens mobilise and 'enliven' their own radiation data in an effort to enact alternate visions of what constitutes harm, and the state's role in the enclosure of such harm through various boundary making techniques.

The final cluster of papers are a more eclectic bunch, but each, nonetheless, touches upon *data concepts* and *approaches to data*. The article from **Kaufmann, Thylstrup, Burgess and Sætnan** – based on a predictive policing study with origins on three different continents - posits and develops a concept the authors call *data criticality*. This term gets at the various *moments* when data become critical to a specific set of practices, activities, or issues. At the same time, the authors suggest that these moments provide an opportunity for critical engagement between scholars and their interlocutors. Through this extensive predictive policing study, the article provides a catalogue of such moments, arguing that each of them - imagining data; generating data; storing data; processing data; and reusing data - render data critical and attune us to the possibility of political action.

Drawing on the work of philosopher of science Isabel Stengers, the paper from **Danholt**, **Klausen** and **Bossen** develops a cosmopolitical approach to data; a way of simultaneously acknowledging both data's realness and their constructedness in a world saturated with uncertainty, interconnectedness and multiple agencies. Central to this approach is the acknowledgement of an inability to fully know what data is capable of yet still take this uncertainty into account. The authors thus explore data cosmopolitically through two empirical examples on the governance and management of healthcare in Denmark, in which data is both given and requires careful and laborious construction in order to become functional.



The article from **Paakonnen** analyses the credibility and legitimacy making techniques around the use of 'big data' in sociological research. Deploying three rhetorical positioning strategies - conservative, reformist, and supplementarist - the article sheds light on the various arguments for doing sociology with 'big data'. The paper not only presents and discusses these arguments, it also reflects upon the different conceptions of what sociology is, or ought to be, in an effort to highlight the various inbuilt ontological and epistemological assumptions *in* and *of* sociology.

*Engaging the data moment* is a special issue that endeavours to take stock of how STS is engaging studies of, in, and with data. Rendering the contemporary as a *data moment* is a way of drawing attention to both a temporal and aesthetic quality that, we suggest, suffuses the datafied developments gathering pace around us. How significant this *moment* becomes, and which forms it takes, remains an open question. Today, much data discourse has a proselytizing and hyperbolic inflection. In looking towards the significance of both temporal and aesthetic questions, this special issue aims to slow down such claims while enlivening the possibility of more equitable and just forms of engagement with data.

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# **Cryptic Commonalities**
# Working Athwart Cryptography, Mathematics and Anthropology

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**DASTS** is the primary academic association for STS in Denmark. Its purpose is to develop the quality and breadth of STS research within Denmark, while generating and developing national and international collaboration.

## Abstract

Based on ongoing interdisciplinary research about advances in a cryptographic technique called Secure Multiparty Computation (MPC), this article explores how research commonalities are carved out among mathematicians, engineers and anthropologists. STS scholars and anthropologists are increasingly engaged in research about and with data scientists and engineers, particularly as this relates to discrimination, surveillance and rights. Cryptography––a sub-genre of mathematics and often-invisible infrastructure enabling secure digital communication––has received less attention. The article argues that the ubiquity of digital computing in our lives necessitates the creation of socio-mathematical vocabularies. Such vocabularies have the potential to lead to new situated data security practices based on local perceptions of rights and protection. STS scholars and anthropologists are uniquely situated to do this work. The article follows three anthropologists in their endeavors to find "cryptic commonalities" by "tacking back and forth" (Cf. Helmreich 2009) between mathematicians', engineers' and their own scientific vocabularies. Despite these attempts, however, the parties often "talk past each other". Instead of shying away from the awkwardness that such moments produce, the authors embrace "epistemic disconcertment" (Cf. Verran 2013a), carving out a space in which they can communicate productively with each other. This space does not turn mathematicians into anthropologists or STS scholars into engineers, but it does make space for a shared scientific "pidgin" that enables collaboration (Cf. Galison 2010). With this pidgin, the authors walk the reader through the logics of MPC, and specifically, a cryptographic technique called "Shamir Secret Sharing" (Shamir 1979). In doing so, we join emerging voices in the crypto-community in an effort to develop cryptographic techniques for social good. This requires not just an understanding of the math, but also the social worlds impacted by these techniques.

**Keywords**: interdisciplinarity, cryptography, socio-mathematical vocabulary, data security, data rights



> Nobody really understood what the [mathematical] function was anyway. The panel discussion afterwards (…) really ended up being about citizens' data security and not about cryptography anyway. Leif[1] said afterwards that this always happens: "People don't get it, and so they talk about what they do get."

This field note excerpt is one of the author's reflections on a research presentation and panel discussion at the People's Political Festival – called Folkemødet in Danish – in June 2018. The authors of this paper are part of a three-year research project funded by a Danish university for the explicit purpose of fostering research relationships across disciplines. The university had chosen to send our research project on cryptography to the festival, showcasing it as a cutting-edge, interdisciplinary project at the festival's "Tech Tent".

The research team consists of engineers, mathematicians, and anthropologists. Together, we are working on the further development of a cryptographic technique called "Secure Multiparty Computation" (MPC). MPC securely computes some function of secret information in a decentralized network with multiple actors. More specifically, our team was working with a scheme called "Shamir's Secret Sharing", which does not cover or hide data, as is the case with traditional cryptography. Instead, it fragments data in such a way that it is nearly impossible to infer the mathematical relation between the fragment and its original data. Our presentation and panel discussion at Folkemødet, noted above, were structured around an app that the team developed to demonstrate how secret sharing works.

As we began the project in 2018, we were regularly told that the mathematics of MPC were somehow inaccessible for those outside high-level mathematics, because, as Leif, a mathematician, noted, "people don't get it." Although Leif's comment referred to our panel discussion at Folkemødet, our experiences in the research group made

[1] All informants' names are pseudonyms, and identifying settings and characteristics have been blurred to protect their identities.

clear that it was also relevant to our collaboration. Put simply, could the authors of this paper "get" cryptography enough to work meaningfully with our colleagues? And did they need to "get" us in order to generate something together? What might "getting it" mean in practice? This article is about our research team's attempts to carve out a new and shared conceptual and practice-able space in which to understand the socio-technical relationship between the mathematical and social work that MPC can do.

In this article, we describe and analyze two kinds of knowledge work, both of which tap into the question of "getting" cryptography, technically and socially. First is the kind of labor that goes into interdisciplinary collaborations: the construction of a common problem where collaboration across anthropology, mathematics and engineering can take place. Second is the work of generating a presentation of MPC for a lay audience at a specific event: Folkemødet. We draw on Stefan Helmreich's (2009) notion of working athwart theory to describe and conceptualize the crafting of a common problem and the construction of a shared itinerary towards 'cryptic commonalities': spaces in which collaboration can happen. The team's researchers belong to different academic communities and disciplines – broadly described as mathematics, engineering and anthropology – and each researcher "tacks back and forth" (ibid 2009:24) between their own discipline and the common project. We show how these athwart movements, which are simultaneously methodological, epistemological and ontological, contribute to the construction of a socio-mathematical vocabulary. This enables commonalities and disconnects between the team's disciplines––centered around MPC––to stand out, rendering them legible, relevant and generative for the research group (and potentially broader publics). We argue that such socio-mathematical vocabularies are necessary in order to enable new data security practices to emerge, situated in specific social settings and based on local perceptions of rights and protection. STS and anthropology have much to offer in the construction of such vocabularies. The article is thus a call for scholars within STS and anthropology to take the work of cryptographers seriously, as sites where social worlds are engaged and created. Specifically, in this historical "data moment", when secure digital communication rests on an invisible cryptographic infrastructure, it is crucial that we (STS and anthropology scholars) engage ourselves in the making of cryptic commonalities.

In what follows, we situate the field of cryptography in relation to other STS and anthropological engagements with data science, and point towards the productive openings that exist for collaborations with colleagues from mathematics and engineering. Thereafter, we address in more detail the epistemological investments involved in establishing a common vocabulary across different forms of knowing (Verran 2013a; 2013b; 2014). Armed with these perspectives, we offer a kind of itinerary of understanding that has evolved over two years of (ongoing) research. We invite the reader to move athwart with us, beginning with the story of MPC and our struggle to "burrow" (Verran 2013a:156) a path to a common language with our research colleagues. With this, we begin to imagine shared research outcomes by working to identify what one of our co-researchers calls the "ontology of the damn problems". After this, we tack back to Folkemødet, and to three examples of how we and our co-researchers moved athwart towards a shared language (Cf. Galison 2010) through the creation of a Secret Sharing app and various modes of explanation (supported by images of an e-mail, a screenshot, and a piece of explanatory code). Old questions about math and ontology remain, but despite this tension, we close with a call to join forces through a shared language that is both possible and necessary. In our pursuit of cryptic commonalities, it becomes possible for us ––STS scholars, anthropologists and cryptographers–– to imagine how local perceptions of rights and protection in specific social settings may be included for the purpose of promoting equitable computational worlds in this data moment.

## Where Cryptography Fits In

STS and anthropological engagement with mathematics and mathematicians is not a large field. In addition to Verran's work (to which we turn shortly), we note Maurer's work on statistics and finance (2002), Miyazaki's scholarship on arbitrage and arbitrageurs (2013), and Engelke's links between Christianity, Number and the work of philosopher Alain Badiou (2010). These contributions situate an interest in mathematics as socially relevant for practices of calculation, financialization and faith. Our study of cryptography adds to this interest in mathematics as socially relevant for practices of security and privacy, particularly since the Internet revolution (Bruun et al. 2020). There are also important critical histories of the use of mathematics in modernity, such as Deringer (2018), that reference the role mathematics has played in notions of quantitative certainty, prediction, risk mitigation and industrialization.

Probability, prediction, statistics, optimization and other mathematical tools are key to the booming field of data science and the growing ubiquity of AI technologies and machine learning methods (Dourish & Bell 2011; Mackenzie 2017). These technologies have caught the attention of venture capitalists, technologists and social scientists alike because they represent a watershed moment of change, both in business models and products, but also in social impact and scale. Here, scale refers to the process of datafication and the enormous amounts of digital data that are generated and required for fine-grained machine learning predictions and advanced analytical algorithms (Alpaydin 2016; Zuboff 2019). The way personal data is being linked to unprecedented numbers of people poses new questions about ethics (Zuboff 2015), law (Richards & Hartzog 2019) and rights (Irani et al., 2016; Taylor, 2017), amongst other things.

The central role that algorithms are now playing in automated decision-making, and the issues of bias and discrimination, in particular, to which they have given rise, have inspired interest among STS scholars and anthropologists in the critical study of algorithms: work examining the everyday life and sociality of the algorithmic present (boyd & Crawford (2012), Dourish (2016), Fisch (2013), Lowrie (2018), Mackenzie (2015), and Seaver (2018)). As Poul Dourish writes, "an awareness has developed that algorithms, somehow mysterious and inevitable, are contributing to the shape of our lives in ways both big and small" (2016:1). The ways these technologies "shape our lives" have inspired a steady stream of erudite STS and anthropological analyses of AI and discrimination, including Barocas & boyd (2017), Barabas (2019), Dourish & Bell (2011), Gray & Suri (2019), Irani et al. (2016), Ochigame (2019), and Selbst et al. (2019), to name just a few.

Cryptographers develop technical tools that have the potential to protect data privacy and offset some of the negative ways in which datafication can lead to mass surveillance. New cryptographic techniques can prevent abuse of data and enable data analysis without revealing that data's content to anyone. Thus, cryptography has always *also* been deeply political, and particualr historical events, such as the breaking of the German Enigma code during World War II and the Cypherpunk movement in the 1980s and 1990s, have played out this political significance. STS scholars and anthropologists have yet to wade into this territory[2], but some cryptographers have. At a key conference in 2015 for the International Association for Cryptologic Research, Phil Rogaway gave a groundbreaking talk[3] entitled "The moral character of cryptographic work" (2015). Normally, each year's distinguished fellow gives a technical talk, but Rogaway had something else on his mind. His abstract reads:

> Cryptography rearranges power: it configures who can do what, from what. This makes cryptography an inherently political tool, and it confers on the field an intrinsically *moral* dimension. The Snowden revelations motivate

[2] Dalsgaard and Gad (2018) address questions of cryptographic techniques in their ethnographic research on e-voting; not as the main object of study but as part of the socio-technical constellation of the digitalization of elections.

[3] The IACR is the flagship organization for cryptographers.

> a reassessment of the political and moral positioning of cryptography. They lead one to ask if our inability to effectively address mass surveillance constitutes a failure of our field. I believe that it does. I call for a community-wide effort to develop more effective means to resist mass surveillance. I plead for a reinvention of our disciplinary culture to attend not only to puzzles and math, but, also, to the societal implications of our work.

From this perspective, cryptography is not "just" math, but a culture that can attend to "moral" work. Rogaway's talk made big waves in the "crypto-community" and although others have not made such prominent pronouncements, they have addressed the ways in which cryptographic work can tackle issues of privacy, data security, surveillance (e.g. Diffie & Landau 2007; Narayanan 2013) and discrimination (e.g. Nissenbaum 2010; Schlesinger et al. 2018). This work signals an opening towards addressing social, political and moral issues connected to cryptography. As we have argued elsewhere (Bruun et al. 2020), cryptography can have a powerful impact on the socio-technical fields in which it is produced, imagined and deployed. As scholars at the intersection of anthropology and STS, we join this critical dialogue around cryptography as a socio-technical constellation, to further develop cryptography for social good. We turn now to the concrete collaboration in which our dialogue with cryptography, and its social interweaving, began.

## Moving Athwart Forms of Knowing

Our cryptographic itinerary began in 2017, when we were approached by Jason, a mathematician and control and systems engineer who was drafting a proposal for a research project on Secure Multiparty Computation. In order to qualify for the solicited grant, the team needed to be interdisciplinary and consist of researchers from different faculties: technical sciences, natural sciences and––preferably



also––human and social sciences. Jason explained that as engineers, they were experts in developing new systems and technologies that function efficiently in themselves, but the humans that use the systems somehow never behave according to the design. How, he asked, could humans be convinced to accept new smart technologies? And how could the technologies be designed in such a way that humans would not compromise their functionality?

At the outset, Jason did not know how anthropologists work; how we pose questions to methodologically and conceptually engage with the world. We, in turn, knew nothing about Secure Multiparty Computation, cryptography or data-security in cyber-physical systems, the focus of the project. We began by formulating research questions, work packages and tasks that we all could foresee as meaningful to the common project and realistic to accomplish. One of the methodological challenges that attracted us was the fact that the technologies developed by the team – MPC and cyber-physical systems––had only been applied in social worlds outside of university math labs to a very limited extent[4]. Thus, our empirical fieldwork would take place among developers (cryptographers) and in settings where such technologies could be implemented in the future. The lack of an empirical and concrete site (field) in which to study the technology in *practice*––called "use-case" in engineering (Barros-Justo et al. 2019)––turned out to be a challenge to establishing a common problem. It meant that we had to create these settings through various experimental formats, such as the Secret Sharing app that we describe below. It also meant that much of our ethnographic material is generated in interaction with and about mathematical theory[5].

[4] Two exceptions are: "Secure Multiparty Computation Goes Live" (Bogetoft et al., 2008), a technical paper on a sugar beet auction and "Accessible Privacy-Preserving Web-Based Data Analysis" (Lapets et al., 2018), a technical paper on the gender pay gap in Boston.

[5] We are quick to add that although "interaction with and about mathematical theory" did not lead us to sites in which we could study MPC in everyday life, it did generate fruitful paths for exploration, including the development of both the Secret Sharing app we describe in this article and a VR prototype, and interacting with researchers at workshops and conferences. These paths deserve to be unpacked in detail, but are beyond the scope of this article.

Cryptography is a highly specialized discipline, and so it is quite difficult for those *not* trained in this field to understand and use the mathematical operations that cryptographically secure data. Echoing Kuhn's paradigms, cryptography could be portrayed by social scientists as "a world apart" (Latour and Woolgar 1986:17), with "news of another world" (Traweek 1992:2) couched in very different knowledge traditions and logics (Verran, 2013a). Even after two years of collaboration, our search for commonalities remain cryptic and are under continuous construction, through concrete encounters that take place across disparate and incommensurable forms of knowing (Verran 2013a), shaped by differing notions of scientific validity, proof, disciplinary belonging and specialization of labor (Galison 2010).

First, we have found it helpful to consider what kind of intellectual space our collaboration occupies. Philosopher of science Peter Galison theorizes interdisciplinary collaboration as a "trading zone" in which scientists from different disciplines can find each other in "common––but restricted––interlanguages" (ibid 2010:51) of "out-talk scientific pidgin". Pidgin (a linguistic term) is stripped of the nuances and depth of the original language, but it is by no means a "lesser" version of it (ibid 2010:47–48); it generates agreement in a delimited space, "where coordination is good enough" (ibid 2010:37). Noting that "science is forever in flux", Galison's examples range from collaborative work between theoretical physicists and radio engineers during WWII to the stabilization of interlanguages into new disciplines, such as nanoscience (2010:33–34).

Secondly, whereas Galison helps us conceptualize interdisciplinarity, STS scholar Helen Verran offers insights into how to qualify the practices and concrete encounters in which different knowledge systems meet. The knowledge encounters that Verran describes and theorizes are postcolonial, situated between modern science and indigenous knowledge traditions: looking at traditional forms of land management through fires in Australia (2013a), or the ontological status of numbers in Nigeria (2014). Although the knowledge encounter we describe takes place at a Scandinavian university, we can learn from the sensitivities and attitudes that Verran develops. One suggestion is to embrace "epistemic disconcertment" (Verran, 2013a), a term that describes and qualifies the moment in which persons with divergent ways of knowing are confronted with a radically different knowledge claim. Crucial in "doing difference together in good faith" is to recognize the difference, and not try to explain it away or deny its truth value (2013b:144–45). In spite of this divide, Verran's perspectives have helped us to identify the quality of our interactions with our co-researchers.

And thirdly, Helmreich offers techniques for navigating in this epistemically disconcerting intellectual space. He explains that working athwart theory "asks for (...) an empirical itinerary of association and relations…", rather than direct representation of comparisons in kind (2009:24). We recognize that establishing cryptic commonalities will not turn mathematicians into anthropologists, or vice versa. But by tacking back and forth, spaces for new understandings are carved out in an ongoing, albeit productively "thin" (Galison 2010:44), and cumulative fashion.

## The story of Secure Multiparty Computation – and our history with it

Formally, Secure Multiparty Computation (MPC) belongs to the field of cryptography. Standard cryptography "hides" data (called "plaintext") by masking it, or covering it with a kind of code (called "cyphertext") that can only be opened with a key. The whole "secret" is thus visible once the key is used. MPC is different. The particular MPC method that we used in the Folkemøde app is called "secret sharing". In 1979, cryptographer Adi Shamir presented the idea of fragmenting data into smaller pieces called "shares" and doing computations on them in a network of participants. This is called Shamir Secret Sharing

Shamir, 1979)[6]. This scheme does not cover or hide the whole secret. It fragments it mathematically so that it is nearly impossible to infer the mathematical relation between the fragment and secret. The whole secret is never submitted to any party (Lapets et al. 2016:5). The techniques informing MPC have existed for decades (Lapets et al. 2018:2), but they have only been deployed for practical use a handful of times since the early 2000s (see note 3). For example, if we wanted to know the average salary for researchers at our university department, we could compute it using MPC. This would give us an analysis that was useful––on average my colleagues earn more than me and I need to ask for a raise––but would protect information about an individual's salary. This is possible because MPC fragments information (i.e. an individual's salary) in such a way, that it is not possible to infer the whole (the salary) from the part because the relationship between whole and part is not obvious. For example, MPC uses techniques that enable a fragment to appear larger than the whole (see footnote 9).

## "I think we're talking past each other"

In order to understand the story of MPC, the authors consulted scientific papers, textbooks, Wikipedia pages and countless YouTube videos[7]. In addition, informal interviews and conversations with and participant observation among cryptographers have provided invaluable insights that have found their way into the story we tell here. For example, in judging whether a particular cryptographic scheme is secure, cryptographers often talk about the relationship between what they call the "ideal world" and the "real world", a distinction that is central to the notion of a "trusted third party" (TTP). A TTP receives encrypted messages, decrypts them and generates an analysis. The TTP must retain trust by not disclosing or using the decrypted messages for its

[6] Another major influence in the development of MPC was "Yao's Garbled Circuits" (Yao, 1986).

[7] See for example "RSA encryption made easy": https://www.youtube.com/watch?v=t-5lACDDoQTk; retrieved 5/9/2020.



own purposes (Tilborg and Jajodia, 2011). But there is growing concern that TTPs may in fact not be trustworthy (See also Bruun et al. 2020). This was the topic of an informal, and initially confused conversation, while waiting for coffee at a cryptography conference (fieldwork for the authors of this paper) with cryptographer, Abe.

> Abe told us [co-author] that the TTP was an example of the "ideal world". She countered: Some actors are not necessarily happy with a TTP, because they're asking to use the data for their own internal analytics. This was not "ideal". Abe insisted that the TTP was part of the "ideal world", but admitted that the term was perhaps abused. On this point, Abe and our co-author agreed. Approaching the debate from another angle, our co-author offered an example: She has a message for Abe that she doesn't want the other café guests to hear. This is "real world", she concluded. Abe countered: This is "ideal world".

As they stood in line, our co-author remarked, "I think we're talking past each other". Abe was surprised, but making the miscommunication explicit made it possible to unpack the terms in greater detail. "Real" and "ideal" have specific meanings for cryptographers that did not match our co-author's understandings. We "ascribed utterly different significance" to the terms discussed (Collins et al. 2010:8). For the co-author, "real" was something that she could experience outside of mathematical theory, in the applied, social world. "Ideal" referred to a best-case scenario that could be imagined, but not experienced. The cryptographer's "ideal world", Abe explained, refers to the ideal mathematical trust and security that the *concept* of a TTP provides: the trusted third party is completely trustworthy, not corrupted (does not share secrets with others), cannot be attacked from the outside, and computes a function of the provided secrets accurately. Elaborating on this, Abe explained that the cryptographic understanding of "real world" had to do with measuring schemes against this "ideal" as a standard. But in cryptography, neither the "ideal world" nor the "real world" has any connection to what we (authors) might call "actual" practice. Rogaway explains, "Most academic cryptography isn't really crypto-for-security *or* crypto-for-privacy: it is, one could say, *crypto-for-crypto*––meaning that it doesn't ostensibly benefit commerce or privacy, and it's quite speculative if it will ever evolve to do either" (2015:24). Abe's definitions remained within the *crypto-for-crypto* logic, whereas our co-author was looking to explain these terms in the context of some practical benefit. Letting Abe know that we were not on the same epistemic page reminds us of Verran's "burrowing device" that "digs" into epistemic disconcertment "by provoking it further" (2013a:156). It was awkward to name the miscommunication, because it felt like a provocation; but doing so bore fruit.

Part of the problem in communicating with cryptographers like Abe is that explanations are usually based in abstract, theoretical concepts. But references to "ideal" and "real" worlds are seductive because they are recognizable as everyday words used outside of mathematics and thereby suggest a conceptual link between the theoretical and the "actual" social world as it is experienced in everyday life. Cryptographers' *theoretical* schemes exist, of course, in the actual world, in the form of papers, presentations and notes on a chalkboard, but the scenarios they imagine them to address do not. In a rare exchange that made these epistemic tensions explicit, one mathematician with whom we are working explained that "all these normative terms [are] being used that really don't map to the technical uses of them". To take another example, cryptographic schemes are populated with "social actors" called "Alice, Bob, Eve, or Mallory", and these actors have social characteristics. They can be malicious (Mallory); they can be curious (Eve, who eavesdrops); they can "cheat", be "corrupted", or be "motivated" to share secret information with outsiders. These figures, however, are purely theoretical in the sense that they are imagined by cryptographers in the form of abstract mathematical assumptions about generalized archetypal characters in the actual world. They have no empirical basis other than the mathematical proofs that show how well a given scheme functions. But following Abe's taxonomy, these characters correspond to the "real" as they represent imagined threats, whereas in an ideal setting, they would not exist at all. Still, cryptographic tools were originally developed for state-centric and military purposes, and later, for civilians to protect what they see as the human right to freedom of opinion and expression (Hellegren, 2017). So, there is a (hi)story linking the mathematics of cryptography and its social relevance in actual practice. But the social practice of the development of cryptographic primitives (theoretical tools) in the academic worlds in which we move is usually driven by mathematical puzzles, not societal problems.

Making "talking past each other" explicit was one way of burrowing towards a shared understanding of the epistemological differences between crypto-for-crypto and crypto in the "actual" world. Another technique was to move closer to the epistemological and social practice of mathematical theory among our colleagues. We now turn to such moments.

## Moving towards a common problem: where is the ontology?

Nate is an engineer with our project, and in our conversation with him about mathematics, he challenged the idea that mathematics is based on pure theory. He brought the researcher's ideation process to the forefront:

> And that's always the problem with mathematics; it's taught in this deductive manner. And that's basically never the way mathematics comes about. It starts with somebody in the shower who thinks he's discovered the theory of everything. It really starts with having some very concrete ideas. You look at some instances that you don't understand (...) and then you discover, "Hey, here

> are some related problems" (…) And then you realize, "Hey, wait a minute, that must mean" this, this and this. And then the general theory comes. But when it's (…) presented, then it's the general theory that's there and the other stuff [is presented] as if it came from the general theory.

Nate explained that there is a tendency among his colleagues to accept new theoretical ideas as "intuition", instead of tracing the ideation process in an explicit way: "The only way we can have a discussion about whether a model is right or wrong is to be explicit about our assumptions. It is typical for a lot of research in our field to be built on intuition, so the assumptions are not made explicit." By challenging "intuition", Nate seems to identify the *researcher's* relationship to the generation of ideas. We recognize Nate's insistence on tracing the ideation process, which we can relate to our own ethnographic thinking. Nate also looks for inspiration from other disciplines in our project:

> So, if you ask [a mathematician], he'll say, "This is the problem I'm solving." (...) This is his area, and this is the way the problem is defined. And the problem we're looking at is a little bit different, right? But I think it's interesting to try and transfer some of the things there and see if we can learn something from it (them), you know?

Nate addresses the questions of identifying the scientific "problem" and of how scientists from different disciplines identify and frame problems differently. In doing so, Nate practices what Verran calls "infracritique", because he recognizes that his colleagues' scientific knowledge is framed differently from his own (2014:530). By taking these differences seriously, he works athwart theory and looks to be inspired in new ways. According to Verran, recognizing these basic differences through "epistemic disconcertment" is the first step toward "doing difference



generatively and in good faith" (Verran 2013a:144). Lest readers think our endeavors were frictionless, it must be said that finding common spaces and "doing difference in good faith" (Verran 2013a:144) were not always possible. Thankfully, Nate was not just curious about his mathematics colleagues, but also about how anthropologists work. He continued:

> So, I was sitting and discussing [this project] with a [friend who is a sociologist] and some colleagues, and [my friend] said, "Well, the first thing you have to do with this, is to establish" - what do you call it? - "an ontology". And I thought, "Hell yes, that's what we're missing in this whole project. We don't know what the damn problems are! We don't have the words, we don't have hierarchies of knowledge and how they relate to each other [and] what problems are relevant to solve." (…) I have no idea if we're actually trying to solve totally irrelevant problems. (...) So, I was hoping that was precisely what you guys could help us understand, [to] help us find use-cases.

For Nate, identifying relevant problems included issues that were both external to mathematics and identifying "hierarchies of knowledge", something he refers to as an "ontology". As we saw in our conversation with Abe, this required continual tacking back and forth (Helmreich 2009:24) between researchers and their respective hierarchies of knowledge: What is ideal, real or actual?

Nate also makes a leap and links the project's ontology to what he refers to as use-cases. In engineering, use-cases are meant "to elicit, to specify and to validate software requirements of a system in terms of the main actors (external elements that interact with the system) and their goals" (Barros-Justo et al. 2019:1). This echoes Jason's initial interest in designing technologies in such a way that their functionality would not be compromised by humans. This was not how we imagined our contribution. We needed to find an "actual" social situation in which

MPC could be used to solve a relevant problem, one in which the main actors' problems and solutions were internal and defined relationally (See Salmond, 2017).

At this early point in the project, we knew very little about each other's disciplinary logics. We lacked both a common problem and a common language. As a mathematician, Abe needed neither a use-case nor a social situation in order to proceed. As an engineer, Nate needed a use-case for his science to be relevant. As anthropologists, a use-case can translate into a social world and actual situations, adjacent to mathematics. An opportunity to imagine a use-case together, as engineers and anthropologists, came with an invitation to present our work on MPC at Folkemødet in the summer of 2018. We return therefore to our Folkemøde app and our mathematics colleague, Leif.



## Making MPC Legible to Ourselves and to Others

In the app, one types in a "secret". The three values that are computed (numbers on the right) are the shares that one makes.

Person 1: From secret s_1, this person makes shares a_1, a_2, a_3 (to begin with, these are kept secret)

Person 2: From secret s_2, this person makes shares b_1, b_2, b_3 (to begin with, these are kept secret)

Person 3: From secret s_3, this person makes shares c_1, c_2, c_3 (to begin with, these are kept secret)

AT NO POINT IN THE PROTOCOL DO ANY OF THE PARTICIPANTS KNOW MORE THAN 5 SHARES (ONE'S OWN 3 SHARES PLUS 2 MORE) !!!!!

Person 1 sends share a_2 to person 2. Person 1 sends share a_3 to person 3.
Person 2 sends share b_1 to person 1. Person 2 sends share b_3 to person 3.
Person 3 sends share c_1 to person 1. Person 3 sends share c_2 to person 2.

Then the first part of computations begin:
Person 1 calculates a_1+b_1+c_1. We call this value sum1.
Person 2 calculates a_2+b_2+c_2. We call this value sum2.
Person 3 calculates a_3+b_3+c_3. We call this value sum3.

The sum of the three secrets can now be calculated as sum1+sum2+sum3. So, if we may not learn anything about each other, but an outside person 4 may learn the sum of secrets, then person 1 sends sum1 to person 4, person 2 sends sum2 to person 4, and person 3 sends sum3 to person 4. Person 4 now adds the three sums together (So, sum1+sum2+sum3) which is the sum of the secrets. In our case, there is no person 4. So in our case, person 1 sends sum1 to person 2 and to person 3. Person 2 sends sum2 to person 1 and person 3, and person 3 sends sum3 to person 1 and to person 2. This way, all three persons can calculate sum1+sum2+sum3, which is the sum of the secrets.

IT IS IMPORTANT THAT NO ONE GAINS ACCESS TO OTHER PIECES OF INFORMATION THAN THOSE DESCRIBED ABOVE.

Figure 1 Translation of the Folkemøde app's MPC function from algorithms to prose.

The Translation above (Figure 1) grew out of the shared idea to develop an app that would demonstrate how it was possible to analyze "secret" information without having access to or disclosing that information. We hoped that demonstrating MPC in an app at Folkemødet would foster an understanding about how it worked and spark public engagement. This required that we burrow deeper into the mathematics, tacking back and forth between modes of knowledge.

Leif, a mathematician with the project, sent us an email explaining (Figure 1) *in words* (and syntax) how MPC functioned in our app. Our interest in the mathematics of MPC was met by some project colleagues with surprise and occasional irritation. "You don't need to know how the math works," one would say when we asked for an explanation. Instead of sending us rows of algorithms and formulas, Leif "translated" his mathematical understanding of the MPC function in our app to written words that we all understood. When we refer to commonalities, we are not suggesting that mathematics and anthropological approaches to MPC are the same; there is no "isomorphism of direct representation" (Helmreich 2009:24). Instead, the commonalities work as a kind of "pidgin". As in Galison's example about collaborative work between theoretical physicists and radio engineers during WWII, Leif "held back" some details, while choosing to put others "on the table" in order to facilitate collaboration (2010:29). His explanation did not convey the full depth of his discipline, but it sketched an itinerary of understanding that connected us. In this instance, Leif reached out to us, so that working athwart theory became a multidimensional endeavor.

## Performing Athwart


Figure 2 Screenshot from the Folkemøde app.

Our presentation at Folkemødet began with Leif's explanation of how MPC could be used to secure citizens' electricity consumption



data in order to optimize the Smart Grid. Thereafter, he introduced our co-author, who presented the app. She explained that it was programmed for several iPads that "carry out secret and secure distributed computations together," adding that the audience could follow along with the computations by viewing the screens in the tent (see Figure 2). We chose to use "real secrets", namely the age when participants first fell in love. There was some playfulness involved in this choice. The team hoped that this light-heartedness would engage the audience and spark their interest in the mathematical functions and their integration into the app's algorithms.

This app screenshot was another version of MPC "pidgin" (Cf. Galison 2010). It did not explain the protocol in prose, but illustrated the ways in which participants' "secrets" were fragmented into "shares". Again, it does not represent the full mathematical project. The upper right corner of the screenshot shows three participants in the network, and next to each name, the fragments of the other participants' secrets. On the left, for the purpose of illustration, one participant's secret is displayed ("your part, 23"), and next to this, the average ("47.67"). The average is the analysis that MPC provides in this protocol. Only the fragments are circulated in the network. The other participants' secrets are not circulated or disclosed, nor do they exist in any back-end version of the app. They cannot be inferred by analyzing the fragments. We pursue how this is possible in the next section. The reason we are able to do this is that multiple athwart movements between mathematicians, engineers and anthropologists have created a trading zone that is "good enough" (Galison, 2010, p. 37) to enable a sufficient explanation.

## The Insides of Secret Sharing

```
def basispoly(F, n):
### F: Finite Field of size m, with m being a prime
              n: Number of parties.
              Creates Lagrange basis-polynomials evaluated in 1 to n and returns a vector of the evaluations.
###
    r = []
    C = range(1,n+1)
    for i in range(1,n+1):
        c = [k for k in C if k != i]
        p = 1
        for j in range(n-1):
            p *= -F(c[j]) / (F(i)-F(c[j]))
        r.append(F(p));
    return r

def secretsharing(F, x, t, n):
### F: Finite Field of size m, with m being a prime
              x: The secret (in F) that will be secret-shared
              t: Degree of the polynomial == number of adversaries
              n: Number of parties
              Generate a random polynomial and evaluates it in 1 to n and return the evaluations = shares.
###
    shares = []
    c = [F.random_element() for i in range(t)]

    for i in range(1, n+1):
        s = x
        for j in range(1,t+1):
            s = F(s) + F(c[j-1]) * F(i)**F(j)
        shares.append(s)

    return shares

def dot(F, x, y):
### F: Finite field of size m, with m being a prime
              x: shares of the secret
              y: output of function basispoly.
              x and y must of same size.
              Ordinary dot product of vectors.
###
    res = 0
    for i in range(len(x)):
        res += F(x[i] * y[i])
    return res
```

Figure 3 MPC explanatory code written in SageMath, designed for the development of the Folkemøde app.

In the explanatory code displayed in Figure 3, the app's key functions are shown in another kind of pidgin. They are written in a language called SageMath (an open source version of Python). We call it pidgin here because the lines above, written by one of our mathematics colleagues, were meant to be simple enough for the app developer (who is not a mathematician) to understand, but detailed enough to stay true to the mathematical functions it should compute. The three key algorithms are: *basispoly (F, n)* which generates Lagrange polynomials[8] from the secrets in a finite field based on a prime number of potential participants in the network; *secretsharing (F, x, t, n)*, which generates "shares" through modular arithmetic and the polynomials in *basispoly (F, n)*; and *dot (F, x, y)*, which reconstructs the secrets.

In what follows, we examine more closely the insides of the *secretsharing (F, x, t, n)* algorithm at the core of Adi Shamir's 1979 MPC scheme and our app. Taking the onto-epistemic underpinnings of this cryptographic scheme seriously is our own attempt to do difference in good faith (Verran 2013a:144), and, significantly, to work towards a shared "ontology of the damn problems," as Nate put it. In other words, we needed to understand how the algorithm works and so we have attempted to unpack it. Our explicit questions about the "insides" of *secretsharing (F, x, t, n)*, may have seemed to our colleagues like the "stutterings of an idiot" (Stengers in Verran 2013a:156). We asked them for feedback on an earlier version of this article, in order to be sure we had described the mathematical functions and relationships correctly. It was returned full of the red markings of a patient but not very impressed math teacher. But our clumsy attempts bore fruit. This is our rendering:

Shamir Secret Sharing (Shamir 1979) is represented in the second step––*secretsharing (F, x, t, n)*––of the explanatory code displayed in Figure 3. *Secretsharing (F, x, t, n)* distributes *only fragments* (or shares) of secrets within a network of at least three parties. In this sense, its distributive scheme is communal. The shares that *secretsharing (F, x, t, n)* generates are based on the participant's secret information, but the shares are *different each time*, even if the number of participants and their secrets are the same. Returning to Figure 2, if we had run the protocol again with the same secrets and number of participants, the shares would have been different, but the average would have been the same. It is significant to note that the shares are significantly *larger* than the original secret. This is the work that the polynomials from *basispoly (F, n)* and the modular arithmetic[9] in *secretsharing (F, x, t, n)* do in the code.

What might this mean socially? How might this rendering help us

[8] Lagrange polynomials lie beyond the scope of this article, but curious readers may consult: https://www.khanacademy.org/math/multivariable-calculus/applications-of-multivariable-derivatives/constrained-optimization/a/lagrange-multipliers-examples; accessed 7/7/2019

[9] Also referred to as "clock arithmetic": https://www.khanacademy.org/computing/computer- science/cryptography/modarithmetic/a/what-is-modular-arithmetic; accessed 7/7/19.

to “attend to the societal implications of our work” (Rogaway 2015)? For Verran, numbers may be understood as cultural practice (2010): they are *conceptual formations* (2013b:28) that need to be explored and “decomposed”. She explains that decomposing a concept such as “a number (…) involves everting to reveal the concept’s insides” (2018:24), also known as “foundationism” (2014:529). By trying to understand the “insides” of secretsharing, we suggest that the changing and counterintuitive share sizes and the scheme’s communal characteristics are informed by a certain kind of “foundationism” that lends itself not only to mathematical puzzle-solving, but also to an investment in using and protecting data that is both robust and communal. If a cryptographic scheme is socially communal, what might this mean in practice for data rights and social good? We do not know the answer to this question, but without unpacking the cryptographic scheme, we and our co-researchers have no common language with which to ask.

We hope that the reader has learned something about the mathematical logics informing MPC and that this might inspire a curiosity in the social implications of cryptographic schemes. In a sense, our pidgin explanation for a Public Engagement in Science extends to you. Perhaps you would like to join the conversation? Perhaps you remain on the outside, not knowing how to ask (Horst and Michael, 2011). But if we are to take seriously the work of “humanizing algorithmic systems,” then we must at the very least cultivate a curiosity about their inner workings, including those of cryptographic systems like MPC, on their own terms (Lowrie 2018:354).

## Emergent Cryptic Commonalities

In this article, we have pursued an itinerary of understanding in which we seek cryptic commonalities with our co-researchers from mathematics and engineering. We began with the questions: Could the authors of this paper “get” cryptography enough to work meaningfully with our colleagues? And did those colleagues need to “get” us in order to generate something together? What might “getting it” mean in practice? We have suggested that “getting it” entailed moving athwart theory, ideally in multiple directions, between anthropology and STS to mathematics, but also between engineering and mathematics, tacking back and forth (Helmreich, 2009). We described how this move into foreign territory could be awkward, particularly when calling attention to miscommunication. But it could also be fruitful if, instead of avoiding epistemic disconcertment, we burrowed further (Verran 2013a:156) and found a shared trading zone. Our colleagues inspired us to consider together how to understand what problems were relevant, even when their ontology was (and is still) not quite determined. Finally, we ventured into ever-deeper layers of understanding, developing a kind of pidgin that enabled us to take MPCs mathematics, its functions and algorithms seriously on their own terms.

Questions remain, of course. We have taken for granted that commonalities may be found, and we have set about generating them, insisting that some form of pidgin translation can facilitate scientific trade across disciplines. For some mathematicians and philosophers, this is foolish. Mathematical physicist and Fellow of the Royal Society (UK) Sir Roger Penrose posited the “math-matter-mind triangle” (Penrose 2007:1029) in which “math arises from the mind, the mind arises out of matter, and that matter can be explained in terms of math” (Hut et al. 2006). The relationships that Penrose’s triangle sets up between math, mind and matter underpins why we think that pursuing cryptic commonalities is both a reasonable and possible endeavor for us to pursue. Nevertheless, some question these relationships; they suggest that math is the origin of everything, implying the “reduction of the world around us, including our minds, to mathematical laws of physics (ibid 2006:2). According to this logic, matter can be reduced to math, and, since the mind is also matter, it too can be reduced to math. This stance does not lend itself to translation (pidgin, or otherwise) trading zones, or burrowing devices that help bridge onto-epistemological confusion. According to anthropologist Matthew Engelke, philosopher Alain Badiou echoes this view: Math is. It resists mediation or representation. “mathematics is ontology” (Badiou in Engleke 2010:815). But cryptographers practiced cryptic commonalities long before we did, fashioning a field that is itself a kind of pidgin. But cryptographers practiced cryptic commonalities long before we did, fashioning a field that is itself a kind of pidgin: a serendipitous construction arising from mathematics, computer science, military strategy, business models, semiotics and much more (Cf. Galison 2010). We add STS and anthropology to this list.

"Cryptic commonalities" is of course a play on words. Our research is ongoing, and Jason has increasingly called upon the anthropologists on his team to explain to outsiders how MPC works. He recently reflected that he struggles to offer a helpful explanation to outsiders because he does not know how and where to begin the translation, in order to choose the appropriate level of information. This means that while he navigates expertly through the hierarchies of his own knowledge, his epistemic tools are somewhat less sharp when he needs to move athwart. In this way, our *common* problem is to further develop cryptography for social good by finding ways to translate these schemes in ways that are socially relevant. But the other way to understand the idea of "cryptic commonalities" is that what and how we are sharing remain *cryptic*.

What we do know is that in this historical moment – characterized by this special issue as a *data moment* – data has gained value in and of itself, leading to the exponential growth of surveillance technologies. For this reason, it is urgent that anthropology, STS, and the social sciences more broadly move in good faith closer to, into, and behind the math driving these technologies. Cryptographer Phil Rogaway called for "a community-wide effort to develop more effective means to resist mass surveillance" (2015). By building cryptic commonalities, we humbly include ourselves in this community. We believe that Rogaway's call requires voices that not only understand the math but also the specific computational social contexts in which it is embedded. Together, this will form a foundation upon which joint social engagement for equitable computational worlds must be built.




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# Beyond issue publics? Curating a corpus of generic Danish debate in the dying days of the Facebook API

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**DASTS** is the primary academic association for STS in Denmark. Its purpose is to develop the quality and breadth of STS research within Denmark, while generating and developing national and international collaboration.

## Abstract

This article recounts and reflects on our experience of interacting with Facebook's data infrastructure during some pivotal months of change in early 2018. We show how the technical affordances of the Application Programming Interface (API) have critical consequences for the practice of digital controversy mapping and hence argue for the necessity of engaging with changes to these affordances: a consequential data moment for digital STS. The tools that controversy mappers have developed over the past 20 years have focused predominantly on the construction and curation of issue-specific datasets. This is partly justified in the theoretical positions underpinning actor-network theoretical controversy analysis, but it is also technically more convenient than demo- or geographical delimitations. Through the example of mapping the Danish HPV debate, we demonstrate the necessity of being able to challenge the issue-specific approach, and we show how this involves direct engagement with the API. We thus provide an inside perspective from a research practice that relies heavily on data from digital platforms and discuss how the closure of public access to API endpoints severely limits this kind of critical engagement.

**Keywords**: Digital methods, Issue publics, Controversy mapping, Facebook, API-based research.

We work in a digital methods laboratory where data are perhaps not so much a moment as they are a permanent condition or an ongoing event. Yet, data certainly have their moments and if there ever was one, January 2018 was it. We had spent the previous year trying to get a sense of what the upcoming European General Data Protection Regulation (GDPR) was going to look like and how it would impact our work. In late November 2017 we received news that Facebook was going to change its public data access in a series of radical steps leading up to GDPR taking effect in May 2018. In the middle of all of it we had to complete a project on the Danish HPV vaccine in a way that



was not supported by our standard tools for doing Facebook research. As a consequence, we found ourselves experimenting with a changing and in many ways dying data infrastructure. We did not come to the data moment having to find out how to engage with it. On the contrary, we were already deeply engaged in trying to solve some fundamental methodological issues when data became a moment. This is an account from within that situation.

In digital STS, the practice of mapping 'issues' (Marres & Rogers 2005) or 'controversies' (Venturini 2012) online typically entails the construction of datasets in which specific types of digital entities are taken to represent engaged actors. On the open web, such a dataset would comprise websites that take a stance in a debate. For example, in the case of the Narmada Dam network in Uzbekistan, Noortje Marres and Richard Rogers built a dataset around the websites of local and international NGOs that articulated different issues in relation to the construction project (Marres & Rogers 2008): on Twitter, it could be user handles tweeting around certain hashtags; on Facebook, groups or pages dedicated to certain topics. Rather than random samples of activity on specific media platforms, much less in national publics or demographic groups – *within which* issues can subsequently be traced and actors identified – datasets in digital controversy mapping are curated and delimited from their inception as the issues and actors of a debate.

The reason for this is at least twofold. *First*, a theoretical emphasis on the 'generative force' of controversies (Whatmore 2009) and their ability to 'spark' new publics 'into being' (Marres 2005) means that issue publics are understood as emergent communities brought into existence by shared stakes in a problem. They can, therefore, not be captured as a random subset of an already known population or electorate, much less of all users in some geographical area. *Second*, the fact that users on most social media do not natively organize according to socio-economic factors but around shared interests, which is why Rogers calls these media 'post-demographic machines' (2009), makes it necessary to think differently about data curation. It is simply impractical to craft representative samples when the full population is not known, filter on the basis of demographic criteria when these are not available as metadata, or make unambiguous geographical delimitations, although it is possible to study how various digital devices perform differently in a national web (Rogers et al. 2012).

What is both more practical, and seemingly more aligned with the understanding that controversies are generative events, is to let a seed of known actors point the researcher to other actors in the idiosyncratic ways of a specific medium. On Twitter, for example, user handles of known actors can point to other relevant handles through follows, mentions, retweets, or replies. On the open web it can happen through hyperlinks; on Facebook through likes, shares, or comments. In this way, controversy mapping solicits the actors, in their media specific guises, to decide who and what should be included, and the result is a dataset which is an analytical result in its own right. If issue publics are emergent, then the first task for digital controversy analysis is to locate them and describe what has emerged in specific situations. The method for generating digital datasets outlined above can be said to accomplish this task, since we presume that the entities comprising the dataset have pointed each other out as a consequence of the controversy.

## The role of tools in the curation of datasets for controversy mapping

The practice of letting actors in a controversy deploy themselves digitally, however, is not only contingent on the idiosyncratic ways in which this can happen on different media, but also on the mechanics of the tools we have at our disposal to do so (Rieder 2020). Early versions of web crawlers like the Issue Crawler (Marres & Rogers 2005) or the Navicrawler (Jacomy et al. 2007), for example, allowed you to input a seed of webpages. From there, the tool would mine all the hyperlinks at a set distance (number of link steps) from those pages and thus collect a corpus of linked web entities. While the Issue Crawler did



so automatically, the Navicrawler prompted the researcher to curate which of the discovered pages to include in the corpus manually. This difference in tool design clearly also entails an analytical difference in how actors are allowed to deploy themselves. Furthermore, neither the Navicrawler nor the Issue Crawler allowed you to discriminate between different sections of a website (such as different national versions of Greenpeace like www.greenpeace.org/africa/ or https://www.greenpeace.org/usa/). That feature has now become available in a crawler like Hyphe (Jacomy et al. 2016), which introduces a difference to what can be delimited as an actor. When we say that an issue public has deployed itself on the web through hyperlinks we have therefore not only followed a specific medium but also a specific 're-tooling' of that medium (Elmer 2006).

Other popular data collection tools in digital STS, such as the Twitter Capture and Analysis Toolkit (Bruns et al. 2014) or the now defunct Netvizz for Facebook (Rieder 2013), are of necessity re-tooling their respective media, with similar consequences. The design of a graphical user interface and a functional backend makes it necessary to choose what kind of digital traces can be followed and how. Without such trade-offs, where user-friendliness is gained at the expense of complexity and choice, there would be little point in building tools in the first place. In this paper we address the consequences of these trade-offs in relation to a particular research problem involving the curation of a generic corpus of public Danish Facebook debate, and in response to a particular data moment prompted by the closure of data access in the aftermath of the Cambridge Analytica scandal and the introduction of the European General Data Protection Regulations (GDPR).

In 2017, while Netvizz was still in function as the preferred tool for doing Facebook research in digital STS, we began a collaboration with a group of doctors and anthropologists to map the controversy around the HPV vaccine in Denmark. Facebook was, at the time, considered to be one of the main catalysts for opposition to the vaccine, especially in the wake of a critical documentary that had been aired by one of the national broadcasters in 2015. To build a dataset with Netvizz, you first had to input the ID of the pages or groups of interest. The tool would then retrieve all posts, comments, and reactions from those groups and pages. If you were interested in a particular controversy, such as that surrounding the HPV vaccine, you would therefore have to construct the dataset around groups or pages where you knew that the debate was taking place, since there was no way to simply ask for all HPV related posts and comments independently of the groups or pages where they had been posted. This was, as we shall see below, a direct consequence of the way Facebook made (and to some extent still makes) data retrieval possible through its so-called Application Programming Interface (API), the data architecture on top of which Netvizz and all other Facebook applications are built.

Netvizz provided two methods for constructing an issue-specific set of pages and groups within the framework afforded by the API. The first was a search engine that identified pages or groups containing certain search terms in their names or 'about' sections. The second was the production of a so-called 'page like network' which allowed you to input the ID of a page and retrieve a dataset of other pages liked by that page. As an example, in a recent analysis of wind energy controversies we used these methods to identify 73 groups and pages protesting wind turbine projects in Denmark and retrieve their posts and comments. This dataset was then treated as the issue public emerging around Danish wind turbines on Facebook (Borch et al. 2020).

As became clear rather quickly in the HPV project, however, the controversy was not only taking place in groups and on pages that were set up specifically to discuss the vaccine. This had, of course, always been true of most debates on Facebook, but it became particularly acute and hard to ignore in a case like the Danish HPV debate where a TV documentary was widely assumed to have sparked much of the controversy. The Facebook page of the broadcaster would, for instance, be an obvious place for people to discuss the documentary. But what about the pages of other news networks or media outlets? Or pages dedicated to tangential issues like alternative medicine, parenting, teenagers, diets, or healthy lifestyles where the documentary could



have been shared and debated? None (or at least very few) of these pages would be found by following likes from vaccine-related pages or querying their 'about' sections for mentions of vaccines.

As a consequence of the way both Netvizz and the API were re-tooling the medium, there was no way of discovering individual posts about vaccines without first having collected all posts from a set of pages and then querying their text. We therefore decided to take a radically different approach. Rather than following the medium to build an issue-specific dataset, we would attempt to build a dataset of public Danish Facebook conversation and subsequently locate traces of the HPV controversy within it. The Atlas of Danish Facebook Culture, as we began calling the project, ultimately covered 24,272,461 posts and 703,693 events from 68,825 pages located in Denmark. These posts and events had been engaged by 19,851,399 users who had reacted 740,635,475 times with a 'like' or an emoji, made 134,381,871 comments, and declared their interest in an event 87,358,664 times (see Appendix A).

## From capturing issue publics to capturing media publics

As we argued in the introduction, attempting to build a corpus that does not trace the contours of some hotly contested topic but claims to reflect a national public conversation as enacted by a platform, sits uneasily with both the theoretical premise of digital controversy mapping and the affordances of online media. Facebook is no exception in this respect. Indeed, you could say that the very idea of Danish Facebook is nonsensical given that users are not restricted by geography in their interactions. As we shall see below, repurposing the API to construct such a dataset has tangible consequences for the way in which a conversation can be said to be 'Danish' or 'public'.

The problem with mapping controversies in topically delimited datasets, however, is that we risk naturalizing any pattern we find as indicative of said controversy. Developments in activity over time in a set of tweets with the same hashtag are easily construed as having something to do with that hashtag (i.e. the dynamics of the controversy) but there is no way of knowing if the changes are actually reflective of some larger trend on the platform. Furthermore, as became clear in our mapping of the HPV debate, the issue-specific datasets that become available through particular re-toolings of a medium like Facebook can be dramatically skewed towards certain types of actors, since those who take the trouble of setting up dedicated groups and pages to discuss vaccines are typically committed to that debate in very particular ways.

A central finding in the project was that Facebook conversations about HPV from the period prior to the airing of the documentary in March 2015 tended to be engaged by two separate groups of users, namely, a group assembling around vaccine-skeptical and another around vaccine-positive posts. As shown in Figure 1 below, these two groups rarely came into contact with each other before the documentary. The networks on the left and right are identical and comprise posts about the HPV vaccine connected by the degree to which they are commented on or reacted to by the same users. On the left, posts from 2012-2013 are highlighted, on the right, posts from 2016-2017. The visual layout is produced with a force vector algorithm, which means that nodes that are visually close can be understood as a cluster of posts engaged by the same group of users. The effect of the documentary, then, was that two isolated groups of users, each either promoting or objecting to the vaccine, became one group of users discussing the vaccine with each other.

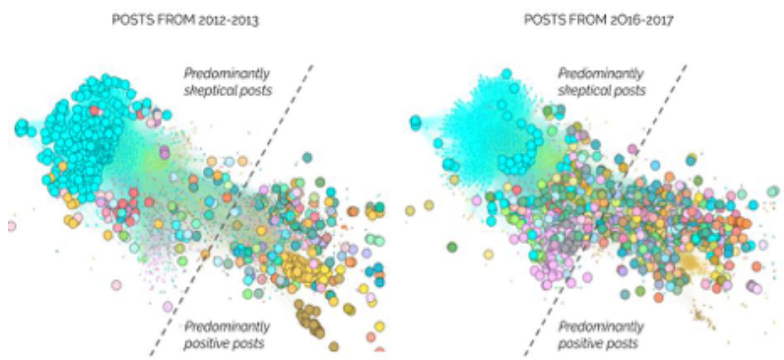


Figure 1: Network of HPV posts connected by user similarity (the degree to which two posts are commented on or reacted to by the same users). Nodes on the left are sized to show posts from 2012-2013; nodes on the right are sized to show posts from 2016-2017. Nodes are colored by the page or group from which the post was harvested.

If the dataset had been topically delimited to groups and pages that were dedicated to vaccine debate, this change in user behavior would have gone unnoticed; so would the scale and perhaps even the existence of the positively inclined user group. As shown in Figure 2 below, the posts that bring the skeptical and the positive user groups into conversation with one another in the years following the documentary are predominantly found on pages that are not dedicated to vaccine issues.

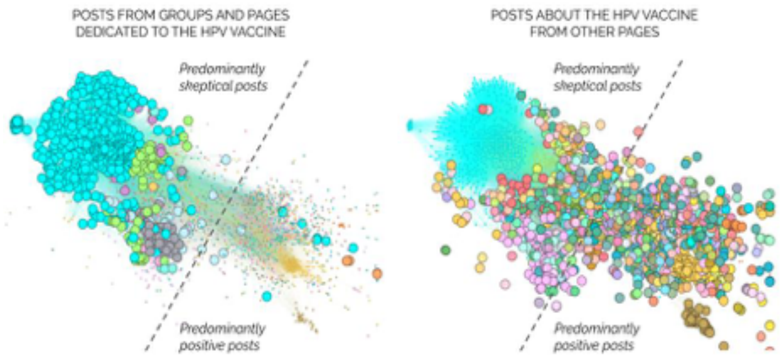


Figure 2: Network of HPV posts connected by user similarity (the degree to which two posts are commented on or reacted to by the same users). Nodes on the left are sized to show posts from issue-specific groups and pages; nodes on the right are sized to show posts about the issue from other pages. Nodes are colored by the page or group from which the post was harvested.

While it is possible on a medium like Twitter to request a random sample of total activity through the API as a baseline for comparison (Gerlitz & Rieder 2013), this is not an option on Facebook. And even when the possibility exists, any platform-wide sample would be unlikely to capture the patterns that are characteristic of a national discourse in a small country like Denmark. The corpus we collected for the atlas project, however, shows clear annual rhythms of precisely such a national character in the way users post and comment (see Figure 3). The holidays in summer, over the new year, and to some extent Easter, are associated with significant dips in monthly post and comment activity. Christmas is associated with an even more marked spike in comment activity. And if we visualize the daily post activity as a ratio of the monthly activity, it is even possible to reproduce the national calendar of public holidays and weekends for each year (see Figure 4). Some of these public holidays, such as Constitution Day on 5 June, are uniquely Danish phenomena. The same is true for days like 29



November, 2015 when Storm Gorm and its ensuing floods created a national emergency, or 27 November 2016 when a new government was announced following a parliamentary crisis. Such days stand out as unusually active.


Figure 3: Number of comments (left vertical axis) versus number of posts (right vertical axis) month by month.

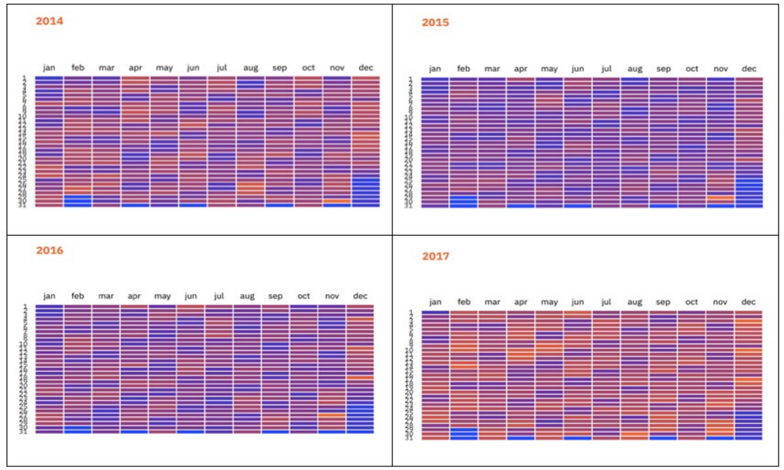


Figure 4: Daily post activity as a ratio of monthly post activity over four years. Blue indicates less activity; orange more activity.

Although social media platforms are post-demographic in the sense that they convene communities of interest rather than representative samples of a population, demography and in this case geography as well, leave tangible imprints on the ways we interact with these platforms. Importantly, however, this does not happen in a correspondence-like fashion where every major event in the 'real' world is straightforwardly reflected in the signal from social media. The national election on 18 June, 2015, for example, is not particularly visible in the post activity. We may not be looking at a specific issue public, but we are certainly not looking at some imprint of 'the general public' either. Media publics, which is what we should assume this to be, co-exist as ongoing results of the shifting ways in which platforms like Facebook, Twitter, or Instagram perform publicity, as shown, for instance, by Andreas Birkbak (2016), Jean Burgess and Ariadna Matamoros-Fernández (2016), or Noortje Marres and David Moats (2015).

Nevertheless, whereas digital STS has devoted considerable attention to such performative media effects in the context of issues (Marres 2015) or controversies (Venturini et al. 2015) – that is, situations where a public is also (and perhaps foremost) brought into being by its stakes in a problem – less consideration has been given to the ongoingness and rhythmicity of media publics themselves. Besides the fact that a comprehensive national mapping of public discourse on a specific medium would be useful for testing claims about political 'echo chambers' (Sunstein 2001) or 'filter bubbles' (Pariser 2011, Hendricks & Hansen 2014), it would also help us situate more case-oriented controversy mapping projects like the analysis of the HPV debate, which was the impetus for building the atlas in the first place. A shift in Facebook activity around a controversial new vaccination program is normally taken as an indication that the issue is heating up or cooling down. The atlas allows you to gauge if such a shift in activity should instead be taken as an expression of wider demographic or media-related rhythms.

One of the clearer indications that the rhythms we observe are closely linked to the intricacies of the medium comes when we track the development in user reactions to content over time (see Figure 5).



Up until 2016 we observe a steady year-by-year increase in the number of 'likes' that resembles the increase we see in post and comment activity (Figure 3). In 2016 and 2017, however, the 'like' count slightly decreases, before it picks up again towards the end of 2017. Facebook users will know that in early 2016 the platform introduced a series of alternative reactions to the conventional 'like'. These emoji-based reactions ('love', 'wow', 'haha', 'sad', 'angry', and for a while also 'pride' and 'thankful', the latter for Mother's Day) offered a wider range of options that could be expected to take attention away from the 'like'. What becomes clear in Figure 5 is how the 'love' reaction specifically filled this role.

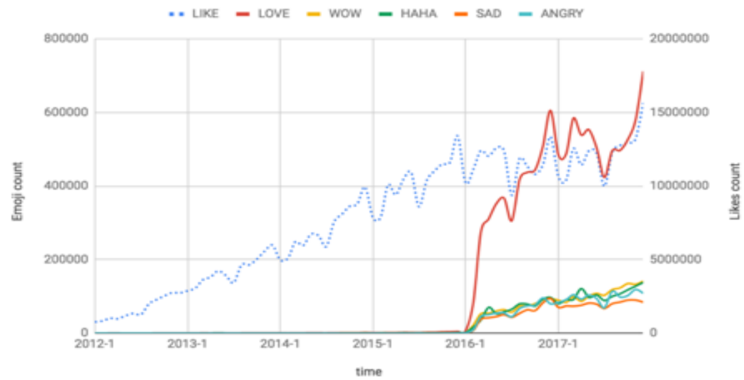


Figure 5: Number of emoji reactions, i.e. 'love', 'wow', 'haha', 'sad' or 'angry' (left vertical axis), versus number of likes (right vertical axis) month by month.

The atlas thus provides a rhythmic backdrop against which we can begin to ground claims about the 'liveness' (Marres & Weltervrede 2013) of issues. The process of constructing the atlas also constituted a good opportunity to consider the grounds on which we can actually talk about and measure features of a particularly Danish discourse or sphere of activity on Facebook. As we will see in the next section, none of this liveliness is available to researchers anymore. We can no longer scrutinize how content or activity gets to be counted as 'public' or 'Danish' in different ways, nor what kind of consequences such constructions have for the analysis. Since none of this was part of the documentation provided in the API reference, the only way to find out was to attempt to produce such a data corpus ourselves, experimentally.

## Engaging the data moment through the dying endpoints of an API

On 7 November, 2017 Facebook announced its intention to 'deprecate' (i.e. discontinue) a number of 'endpoints' for its API.[1] These endpoints allowed third parties to retrieve user-related information from public Facebook pages. Three months later, on 30 January, 2018, similar deprecations were announced for endpoints relating to open Facebook groups and events.[2] Since the changes would effectively break existing third-party applications (hence categorized as so-called 'breaking changes' by Facebook itself), they were announced with 90 days prior warning in order to give developers of these applications a chance to come up with new designs and revise their code. In many cases, however, the announced deprecations jeopardized the relationship between the platform and its third-party stakeholders. This was not least the case in digital methods research where apps like Netvizz, which had served the research community as a tried and tested tool for API-based data retrieval and platform scrutiny (e.g. van Es et al. 2014, Munk 2014, Rieder et al. 2015, Lev-On et al. 2015, Poell et al. 2016, Larsson 2016, Ben-David & Matamoros-Fernández 2016, Farkas et al. 2018, Madsen & Munk 2019), were suddenly existentially threatened.[3]

It was not the first time that breaking changes to the API had been announced, nor was it the first time that they would impact the data

[1] Changes to the Facebook Graph API announced as v2.11 on 7 November, 2017: https://developers.facebook.com/docs/graph-api/changelog/version2.11#gapi-90 (last accessed 30 April, 2019).

[2] Changes to the Facebook Graph API announced as v2.12 on 30 January, 2018: https://developers.facebook.com/docs/graph-api/changelog/version2.12 (last accessed 30 April, 2019).

[3] From August 2019 Netvizz was no longer publicly available.



tools available to digital methods research. Indeed, when the abuse by political consultancies like Cambridge Analytica first came to the platform's attention in 2015, Facebook deprecated all API endpoints that, at the time, gave third parties access to private profile information, such as the friends network of any member of an open group. The reason for these deprecations only came to the public's attention much later in spring 2018, but they were clearly noticed by the research community as they were put into effect (Rider 2015). Generally speaking, these 2015 API changes were seen as a long-needed move to shore up some of the blatant privacy problems in the way Facebook shared data with its third parties. The changes that were announced to take effect in early 2018, however, prompted a much more complex set of questions and concerns.

On the one hand, the user-related information that Facebook wanted to prevent third parties from harvesting could, if treated in sufficient volume, be misused to profile individuals and thus target political content. A like or a comment on a public page may not be private or sensitive information, but it is certainly personally identifiable information, which meant that it would fall within the remit of the upcoming European General Data Protection Regulation (GDPR). It is also the kind of information that machine-learning algorithms can use to guess otherwise undisclosed personal characteristics of the user, such as gender, political orientation, or level of education (e.g. Kristensen et al. 2017). In the age of big data analysis this is in itself an argument in favor of limiting access to data.

On the other hand, we were talking about information that had been deliberately self-published by users, often in an effort to influence a debate, advocate a point, and thus sway public opinion. It had been deposited as posts, comments, and 'likes' on the pages of political parties, companies, and interest organizations as part of a public conversation. Relevant questions about the spread of misinformation, the polarization of online conversation, the role of bots and fake profiles in political debate, or the ability of citizens to organize and mobilize around their matters of concern would become much harder to answer after the API changes took effect. From a digital methods perspective, and arguably also from the point of view of a democratic interest in the way social media platforms and the multinational corporations behind them have become part of public life, limited data access posed a serious challenge. Indeed, Facebook would still be selling the ability to tailor campaigns and target users with specific interests or demographic characteristics (this was still the case in November 2019). The announced deprecations would prevent third parties from doing so, but not Facebook itself, the argument being that the platform could then control how content was being targeted and, as they have to some extent started doing, make it transparent who was buying. The capacity to target content, however, would still be available to political operatives and commercial actors alike.

In late 2017, Facebook was by far the preferred social media platform and thereby also the dominant arena for public debate and news dissemination in Denmark and other Western countries. In the wake of Brexit and the Trump election it had become commonplace to question the democratic consequences of this dominance critically, questions that could only be answered if there was a public record documenting which stories were being shared and circulated by whom. There was a schism, then, between Facebook taking back control of its publicly available data and the platform closing itself off from public scrutiny (e.g. Perriam & Birkbak 2019, Venturini & Rogers 2019, Ben-David 2020). The potential clash between the need for democratic society to conduct inquiries on the state of its own public sphere, concerns about privacy and personal information in the age of algorithms, the role and power of multinational media corporations, and attempts to make such corporations accountable through regulation, landed us squarely in the intricacies of what the editors of this special issue call 'the data moment'. The question was: how to engage it?

Engaging the dying endpoints of the Graph API to construct a corpus of the magnitude of the atlas in a relatively short time frame (we had 4 weeks at our disposal from the decision was made until the API changes kicked in) turned out to be a productive empirical situation in the



Deweyan sense that the framing of the problem had to be negotiated in an ongoing process of inquiry (Dewey 1938). It was one that involved, among other things, the API environment, the technical means at our disposal for interacting with this environment, the changing privacy policies and regulations, our own research interests, and the need for robust protocols that would support these interests.

As pointed out by Mirko Tobias Schäfer and Karin van Es in the introduction to their edited volume, *The Datafied Society*, "the translation of the social into data involves a process of abstraction that compels certain compromises to be made as the data are generated, collected, selected and analysed" (Schäfer & Es 2017:13). Negotiating the endpoints of the API to construct a representation of public life on Danish Facebook required a series of such translations, each of which constituted its own potential occasion for learning and critical reflection. We thus took the construction of the atlas as an occasion to move into 'critical proximity' (Latour 2005, Birkbak et al. 2015) with Facebook as a research infrastructure. Coming back to *The Datafied Society*, José van Dijck notes in his foreword that:

> In a society where many aspects of language, discourse and culture have been datafied, it is imperative to scrutinize the conditions and contexts from which they emanate. Researchers from the humanities and social sciences increasingly realize they have to valorise data originating from Web platforms, devices and repositories as significant cultural research objects. Data have become ontological and epistemological objects of research – manifestations of social interaction and cultural production. (Schäfer & Es 2017: 11)

When we are doing research on and with Facebook, such 'conditions and contexts' (that we must imperatively scrutinize) are often features of the API environment. Some of the most commonly used data capture tools for Facebook have been built as applications on top of publicly accessible API endpoints and it has been suggested that we sometimes need to move beyond such tools because they are easily conflated with the platform itself; we can tend to naturalize the data-world offered to us by the tool as if this was the data-world of the platform (Skeggs & Yuill 2016). As we will see in the following sections, the consequences of this conflation become extremely tangible and anything but trivial when you have to decide what to count as *public* and as *Danish* in the construction of a dataset.

## Negotiating 'publicness' between the API and the GDPR

What is private and public is not an easy distinction to make online (Birkbak 2013). This is also the case on Facebook where different levels and versions of publicness coexist and intersect. *Pages* are certainly public. They cannot host a closed forum or be kept secret. The administrators of a page can decide not to let visitors author their own posts, but whatever happens on a page remains visible to everyone. This visibility even extends to people who are not on Facebook. Similarly, it is not necessary to like a page to be able to comment on or react to posts on the page. *Groups* can be public as well, although in a slightly different way. If a group is set to 'public', non-members can openly follow the discussion, read the comments, and see who is reacting, although you have to be a member to comment or react yourself. If a group is set to 'closed' or 'secret' you have to be approved as a member by the group's administrators in order to follow the discussion. Members of such groups can thus have a reasonable expectation of privacy, although arguments could be made that if a group has enough members it should no longer be characterized as a private forum. Something similar is the case for personal profiles where users have a reasonable expectation of privacy, except in some cases where users have so many friends and/or have loosened privacy settings to such an extent that their personal profile pages effectively become public forums.



When we tried to determine these questions in conversation with the API, however, the outcome was quite different. Without a special access token (specific permission from a user or an admin of a group), it was impossible to retrieve information from personal profiles or closed/secret groups. From the point of view of the API as it looked in January 2018, there was a clear distinction between the kind of publicness you could argue for open groups and pages and the kind of publicness you could argue for very large closed groups or private profiles with public settings. Prior to the 2018 changes there was arguably some alignment between endpoints that the API allowed you to call without a specially obtained access token, and material that was already publicly available to anyone on or off Facebook. Posts, comments, and reactions from pages and public groups could thus be requested from the API with a generic access token, whereas the same material from a closed group or a personal profile could only be obtained with the express permission (in the form of a temporary access token) from the user or group administrator in question. As we have already discussed, this alignment was only partial since it could be argued in certain circumstances that closed groups are indeed public forums. However, even this partial alignment was temporary. The announced API deprecations would effectively make most of the self-published material from pages and public groups unavailable. At the moment of harvest, then, it was possible to establish a definition of publicness that could be aligned with the API, but part of what made this moment so momentary was the fact that this alignment was not going to last.

One of the reasons why the API endpoints were being deprecated was very clearly GDPR-related. Or rather, GDPR was not yet phased in but the prospect of it being so was certainly on everybody's mind in 2018, and Facebook used it as part of its justification for the announced changes. Even though the material available through the page endpoints had been self-published, it was nonetheless personally identifiable information. The fact that the information is public makes anonymization almost impossible since a simple Google search for the full text of any comment or a post will immediately reveal the name of its author. Notably, the latter does not even require that the person who is performing the search is logged into Facebook and this is still the case after the deprecation of the endpoints. The situation is somewhat paradoxical: the same publicness that seems to make page interactions on Facebook legitimate objects of research, in the sense that they are already in the public domain, also makes them harder to treat in a GDPR-compliant way. The first question that the construction of the corpus prompted, then, was whether there was a genuine research purpose that justified treatment of the data.

Since it is not possible to obtain informed consent from millions of users, the only way to treat personally identifiable social media data in a GDPR-compliant way is by justifying a research interest. And since it is not possible to use this justification without making the data subjects aware that the treatment is taking place, which is equally unfeasible with millions of users unless the data is already available through a third party, it becomes even more important to argue how the API makes what kind of data available without further consent. The data registration procedures of our university thus became a key factor in determining how we defined 'publicness'.

As we have laid out above, being able to ground the apparent liveness of issues against national or media-related rhythms is certainly of interest to digital STS research. That, and the fact that we could document that the data we were harvesting were both self-published and already being made available to third parties through the API, allowed us to complete the necessary data registration. Doing so, however, also meant that the data for the atlas would have a limited life. Once treated for the purposes laid out in the original registration the corpus must either be deleted or anonymized. As we have already discussed, the latter is near impossible, and we have therefore committed to deleting parts of the corpus when the treatment is over.



## Negotiating 'Danishness' with a post-demographic machine

A more difficult problem arose when we had to decide from which pages or groups to harvest data. While the API of the day could help us argue for a version of publicness that was aligned with the availability of data, it was less clear how it could help us define Danishness in a way that could be put to practical use. As described earlier, Netvizz comprised a search module that allowed you to discover pages or groups based on different query terms. This was well adapted to an issue-based approach to building corpora but not of much use for building a national corpus. In this respect, Netvizz seemed to reflect the possibilities of the API, which offered no way of searching for all pages and groups from Denmark. There was, however, another option that was not built into the tool but could be accessed by calling the API directly. Facebook places – locations where users have the ability to check in when they post – could be discovered through a geographical search module. We could thus draw circles around a series of geographical points with a 5km radius, covering the territory of Denmark, and then call the API to retrieve more than 70,000 places where users can check in. As it happens, some of these places are also pages: for example, when a restaurant, a theatre, or a university offers the possibility to check in. In our case we ended up with 2,454 places that we could verify as being pages. Figure 6 shows how a page (in this case our own) contains location information that can be used to check in. These pages became the seed from which to begin the construction of the corpus.

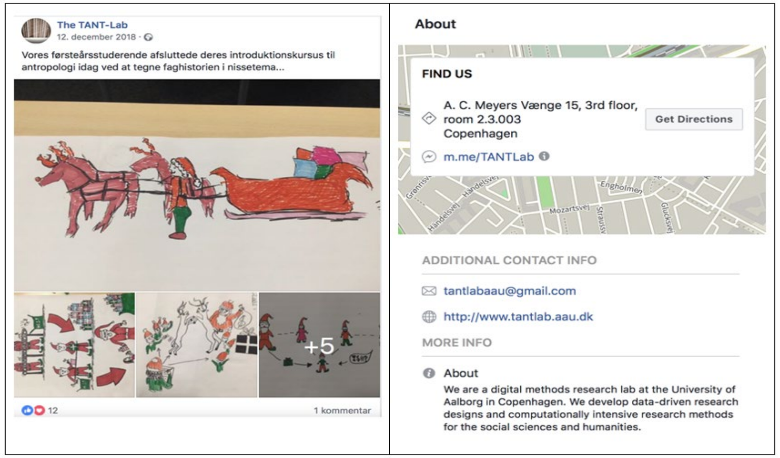


Figure 6: Example of page post with comments and reactions (left) and an 'about' section with location info (right).

We then decided on a strategy of snowballing. We would start with the seed list of known Danish Facebook pages (pages with a geographical location inside the territory of Denmark) and ask the API which other pages they 'liked'. In the same API call we would specify that we were not only interested in the names and IDs of these 'liked' pages, but also in their location info if available. This allowed us to filter the results returned by the API so that we were left with a new list of pages that all had the country 'Denmark' in their location info and were not already present in the seed list. The process could in principle be repeated until no new pages were found. In practice we proceeded through 15 iterations to find a total of 68,825 pages that we could claim to be public and Danish at the same time. The fact, however, that this combination of page location info and page likes, and the associated API endpoints, became the way in which we could operationalize the construction of the corpus, also meant that public groups could not become part of the corpus. It is not possible for groups on Facebook to like each other and the API offered no other possibility for snowballing more groups from a seed list of groups, except to search through the actual post activity of the group for links to other groups, which we assessed to be unrealistic under the given time constraints. Groups are also not allowed to have a location with country info. It would therefore have been hard to determine which groups were Danish and which were not, based on criteria comparable to those used for pages.

We considered alternatives to the location-based criteria for Danishness, the most obvious one being a linguistic criterion. Implementing such a criterion would first of all have required an additional step for each new page or group we had to evaluate in the snowball where we would perform language recognition on the description of the page. This was also a challenge within our limited time frame and it obviously assumes that Danish pages speak Danish. Pages that are geographically located in Denmark but communicate in English (as is the case for certain restaurants or bars, for instance) would thus not be recognized. As shown in Figure 7 below, 17,537 of the geographically defined Danish pages in the atlas have non-Danish 'about' sections

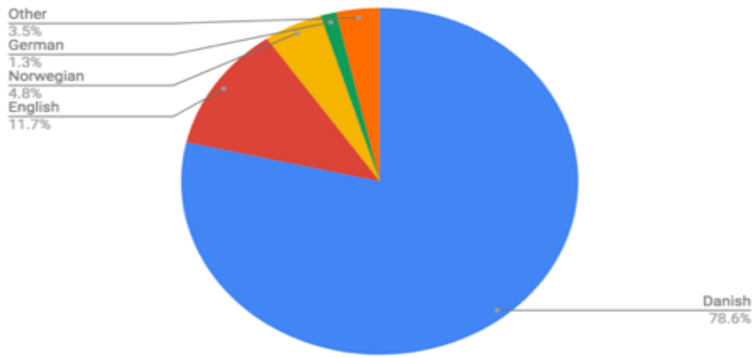


Figure 7: Distribution of detected languages in the 'about' sections from 62,067 Facebook pages geo-located in Denmark. Language detection failed on 6,758 pages which are not included in the diagram.

Even with a geographical criterion there were multiple ways to proceed. Our initial (and eventual) inclination was to go with the self-declared country stated by a page in its location info. There are pages, however, that do not declare a country in this section even though they clearly have an address with a Danish city, postal code, street name, and sometimes even geographical coordinate. As an experiment we scraped a list of 4,092 Danish place names from the geography section of the online version of the Great Danish Encyclopedia.[4] We then asked the API to return pages with a city matching one of the places on the list. This produced an additional 2,454 pages that were not already part of the corpus. None of these pages had 'Denmark' as their country (this is to be expected as they would otherwise likely have been found in our first snowball). Some of the pages state other countries while some of them do not state a country at all. The former come in different categories. A page like *Events Bornholm*, for example, which advertises events on the Baltic Island of Bornholm and was found through the search for city names, erroneously has 'Australia' as its country. Sometimes the Danish place names are ambiguous. This is the case for pages from the city of Greve which happens to be both one of Copenhagen's southern suburbs and a market town in Tuscany (Greve in Chianti). Then there are formerly Danish places, notably in Northern Germany and Southern Sweden, which emerge as an effect of using an encyclopedia with a historic perspective as the ground truth for what counts as places in Denmark!

## Conclusion

We have discussed some of the consequences involved in re-tooling a post-demographic machine like Facebook to construct a generic corpus of public Danish debate. The construction of such a behemoth data body involved non-trivial choices about what should count as 'Danish' or 'public'; how such notions could be operationalized within the technical constraints of the Facebook API; the tools available for interacting with it; the mechanisms for storing and accessing data; the time and resource constraints imposed by the reality of API changes (announced and unannounced); how the construction could be justified in relation to GDPR, which in itself turned out to have far reaching technical ramifications; and how to square this with various platform policies. We had to decide, for example, whether 'Danish Facebook' should be defined as the parts of Facebook that speak Danish. Such a translation would exclude non-Danish speaking pages but also necessitate the use of a language detection algorithm, which requires a fairly substantial input of text in order to work and therefore takes time. Even though this extra time is negligible for one page, over the course of thousands of pages it would jeopardize the ability to get data before the closure of the API. In the end, curating a corpus of generic Danish Facebook debate is a matter of negotiating a host of situations that all, in their own ways, embed the complexities of the data moment. Learning to talk to the API through a process of 'explorative programming' (Montfort 2016), that is, scripting API commands and experimenting with the returned results to piece together a strategy in the absence of proper documentation, made it possible to construct a version of what 'public' and 'Danish' could realistically mean in a conversation with the medium.

We have also argued that the construction of such datasets is of critical importance to the practice of controversy mapping in digital STS. We have showed that a strategy of data collection based around issues risks missing important parts of a debate. It can lead us to mistake the rhythms of a medium or a national context for signals in a controversy. As an example, we showed how a conventional approach to capturing the issue public around the HPV debate on Facebook would have left us with a dataset that did not include the pivotal moment when skeptics and supporters of the vaccine began debating each other in the wake of a critical documentary. Although most digital media are more amenable to an issue-oriented data generation strategy, following from the tendency of users to organize in communities of interest rather than along demographic or geographic distinctions, as well as the tendency of both media and data collection tools to support such organization, the case of the Danish Facebook atlas demonstrates the importance of comparing the consequences of this issue orientation

[4] http://denstoredanske.dk/Danmarks_geografi_og_historie/Danmarks_geografi, accessed January 2018.

against other ways of curating datasets. The ongoing closure of API endpoints makes such comparisons increasingly unfeasible and digital STS should therefore consider them as urgent data moments to be explored and exploited as occasions for critical proximity with the media infrastructures on which we rely.

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# Appendix A

| Interaction type | Unique users | Occurrences | Average occurrences per user associated with this interaction type | Average occurrences per user (all users) | Percentage of all reactions | Unique users as a percentage of all users |
|---|---|---|---|---|---|---|
| LIKE | 17.390.933 | 700.124.571 | 40,3 | 35,3886 | 96,7573 | 87,9045 |
| LOVE | 1.592.781 | 13.547.241 | 8,5 | 0,6848 | 1,8722 | 8,0509 |
| WOW | 634.291 | 2.559.839 | 4,0 | 0,1294 | 0,3538 | 3,2061 |
| HAHA | 778.776 | 3.037.078 | 3,9 | 0,1535 | 0,4197 | 3,9364 |
| SAD | 550.409 | 1.966.947 | 3,6 | 0,0994 | 0,2718 | 2,7821 |
| ANGRY | 500.008 | 2.334.429 | 4,7 | 0,1180 | 0,3226 | 2,5273 |
| THANKFUL | 9.147 | 10.899 | 1,2 | 0,0006 | 0,0015 | 0,0462 |
| PRIDE | 4.222 | 7.184 | 1,7 | 0,0004 | 0,0010 | 0,0213 |
| POSTS | 784.819 | 2.337.439 | 3,0 | 0,1181 | N/A | 3,9670 |
| COMMENTS | 4.108.573 | 127.223.812 | 31,0 | 6,4307 | N/A | 20,7673 |
| PAGES | 18.163.312 | 192.799.568 | 10,6 | 9,7453 | N/A | 91,8086 |
| EVENTS | 4.540.469 | 87.358.664 | 19,2 | 4,4156 | N/A | 22,9503 |
| ALL INTERACTIONS | 19.593.459 | 940.470.710 | 48,0 | 47,5372 | N/A | 99,0375 |

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# Exploring the Trading Zones of Digital STS

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## Abstract

Over the last couple of decades, one of the significant developments in digital STS has been the rapid growth in digital methods and tools for data harvesting, analysis and visualisation. The increasing availability and deployment of digital tools raises questions about how to develop an analytic practice that reconciles the theoretical sensibilities of STS with tools and data that may sometimes be grounded in assumptions alien to STS. This article explores these challenges by reporting on two related digital STS projects that were carried out at the Techno-Anthropology Lab in Copenhagen. Drawing on science historian Peter Galison's notion of trading zones, the article analyses how project participants from different communities of practice exchanged and combined tools, theories and projects in a variety of ways. The article identifies two particular trading strategies: the introduction of assisting ontologies or mini-theories, and the introduction of project-specific problems and success criteria. In the final discussion, the article argues that a reliance on these trading strategies in the future will require digital STS to maintain and cultivate its theoretical sensibilities through a continued dialogue with the broader field of STS, including, in particular, new interventionist forms of STS scholarship.

**Keywords**: Trading zone, Digital STS, Digital methods, Actor-network theory, Modularity class.

## Introduction: New tools and new challenges in STS

The field of STS has been exploring the role of scientific tools and instruments for a very long time. Its anthropological studies of laboratories described scientific instruments as inscription devices that translated physical phenomena into figures and text, later enabling scientists to draw things together and create powerful centres of calculation (Latour 1987, Knorr-Cetina 1995). Historians of science have described how new instruments and methods established specific standards for objectivity, which simultaneously created ideals for the scientist as a particular kind of scientific subject (Shapin & Schaffer 1985, Haraway 1988, Daston & Galison 2007). Feminist and infrastructure studies have shown how the standards and classification of tools and instruments may perpetuate built-in assumptions, create particular kinds of visibility and invisibility and lead to unevenly distributed consequences and benefits (Akrich 1992, Bowker & Star 2000, Law 2004). To put it briefly, STS scholars have shown scientific tools to be a creative, powerful source of world-articulation and construction, while, at the same time, being problematic, contested, and an inevitable cause of invisibility and marginalisation.

With this backdrop, it is noteworthy that the tools and instruments of our own field––of STS––are also constantly growing and undergoing revision. The specific development on which I focus in this article is the rapid growth of digital tools in STS. Over the last couple of decades, an increasing number of STS researchers have begun to use and develop digital tools for data harvesting, analysis and visualisation. In some respects, these new tools resemble tools that STS researchers previously studied in the hands of others—tools that construct worlds, define subjectivities and create new invisibilities. One of the first and now classic examples of a digital tool in STS was the Issue Crawler, which was developed by Marres and Rogers (2008). This device—a so-called web crawler—was used to trace the network of hyperlinks between homepages. Thus, the Issue Crawler would be fed the URLs of a few homepages that were relevant to a particular issue, say the construction of a dam in Central Asia (Marres & Rogers 2008). From this starting point, the Issue Crawler would follow the hyperlinks of the first set of homepages to a second set of homepages, which would, in turn, contain hyperlinks that could be followed to a third wave of homepage. Based on this crawling, the Issue Crawler would produce a visualisation––a network graph––showing which homepages were hyperlinking to each other, and, hence, provide an image of a peculiar type of ontology performed by the homepages, namely, identifying which home pages were recognised as relevant by the other homepages engaged with a particular issue. Using this tool, STS researchers employed a practice that was similar to that of other developers of scientific tools. They created new knowledge, since no one had surveyed issues in this way before; they created new invisibilities, emphasising hyperlinks rather than other kinds of online and offline associations; and they created new subjects of science, as STS researchers began to present themselves as contributors to the articulation of issue publics.

The Issue Crawler was the beginning of what has now become a large assembly of tools for a variety of different kinds of data harvesting, automated analysis and visualisation. A growing number of people in STS find the use and development of digital tools to be an interesting development. However, it should be noted that the field of digital STS includes several other types of research, including speculative design, as well as more traditional ethnographic fieldwork studies of digital practices (Vertesi & Ribes 2019).

I belong to the part of the digital STS community that believes that the deployment and development of digital methods within STS work is an important vehicle for studying not only the digital but also the social in a broader sense. However, my aim here is not to advocate. The aim of this article is to focus attention on how exactly STS researchers manage to incorporate digital tools into their projects in practice and, in particular, how they manage to reconcile specific tools with their broader theoretical commitments and analytical interests. I do this by presenting an up-close and partly autobiographical account of the tensions, difficulties, and possible solutions that arose in two related projects that had committed themselves to a data-intensive, digital methods approach. This close study of situated tool practices is important, because it gives us a glimpse into how a part of our field is currently developing data and tool practices in close collaboration with adjacent fields, such as media studies and data visualisation.

To reflect on the role and negotiation of tools, I draw on Galison's (1997) notion of trading zones, which he uses to describe how the relatively uncoordinated development of tools, theories and experiments in the field of physics nevertheless come together at particular locations. I briefly present Galison's ideas in the first part of the article. Following this, I describe the two related digital projects, which together serve as the article's main case. I follow the projects through a series of struggles to reconcile tools and theoretical commitments. Third, I conclude with a reflection on what we might learn from this case about the future development of an STS equipped with digital tools.

## On tools and theories

The American historian of science, Peter Galison, has described and analysed the history of physics in a number of widely read books (Galison 1987, 1997; Daston & Galison 2007). Physics is generally recognised as a strong and stable field with a very long and proud history. However, despite this, Galison observes that physics is characterised by a great deal of disunity; the field consists of several communities, most notably, experimentalists, tool builders and theorists. Each of these groups has their own journals, conferences, summer schools, invisible colleges, specialized institutions, and career paths. When a change happens in one community, the others do not necessarily change at the same time. Even a radical theoretical change, such as the introduction of Einstein's theory of relativity, did not cause an equally radical rupture in the practices of instrumentalist or experimentalist physicists. On the contrary, Galison describes how both Einstein and the pre-relativistic Newtonian opponents of his theory all agreed to continue building on the same data from the same experimentalists. This observation of continuity in some dimensions at a time of rupture in others leads Galison to propose an 'intercalated periodization' (Galison 1997:799; see also Figure 1). Intercalation—layered, asynchronized development—explains how the *dis*unity of science is actually a source of strength and continuity rather than a source of fragmentation (see

Figure 1)[1]. Galison suggests that this is very similar to how the strength of a thread comes from the multiple fibres woven into it rather than the continuation of one particular fibre.

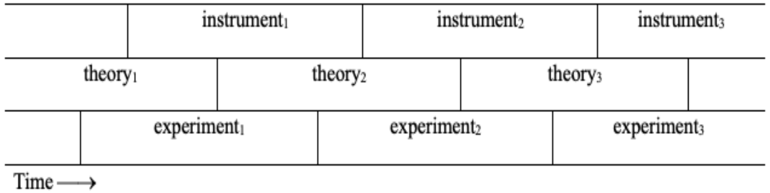


Figure 1: Galison's depiction of the intercalated development of instruments, theories and experiments in physics. Drawn from Galison (1997: 799).

If instruments, theories and experiments are potentially out of sync as they develop within different communities, then it becomes important to understand how they are connected in practice. To this end, Galison introduces the notion of a *trading zone*, which he borrows from anthropological analyses of how different cultures come into contact with each other (Galison 1997: 804). For Galison, a trading zone is a specific location where instrument builders, theorists and/or experimentalists come into direct contact. One example was the Los Alamos project during WWII, where several types of physicists and engineers located in the same building worked on developing the hydrogen bomb. Galison emphasises that trading zones are not melting pots where cultural differences blend into uniformity. Trading zones are locations where communities develop boundary objects (Star & Griesemer 1989), simplified pidgin languages or hybrid creole languages that may facilitate exchange. These local symbolic and material actions, Galison argues, bind together the culture of science.

The field of physics is obviously vastly different from the field of digital STS in terms of history, size, resources and circumstances. However, I would still contend that the challenge of connecting different layers or communities is not entirely dissimilar. Digital STS has a number of theoretical commitments, which are largely shared with the broader community of STS researchers (Vertesi & Ribes 2019). Digital STS also involves interacting with communities of software developers and data visualisation specialists, who constantly offer new digital tools and data opportunities (Venturini et al. 2017). Finally, digital STS scholars are working with a range of different partners and collaborators outside STS on an incessant stream of projects that always come with their own agendas (Munk et al. 2019; Elgaard Jensen et al. 2020). There is, therefore, plenty of need to create trading zones where communities come together and test possible connections between theories, tools and projects. It is precisely this kind of pragmatic trading zone dynamic that I attempt to portray with the case below. I present the events from an insider's view as I was a participant in both projects. The flow of events that I define as the case includes shifts in the tool layer, the theory layer and the project layer (see Figure 2). However, pointing out the shifts in the various layers is merely a preliminary step. The key question that I pursue across these shifts is how the participants in the case (including myself) managed to create material and symbolic devices that allowed us to combine the layers and move a small step forward with our projects. It is this trading zone work that I wish to articulate and reflect upon in my final discussion.

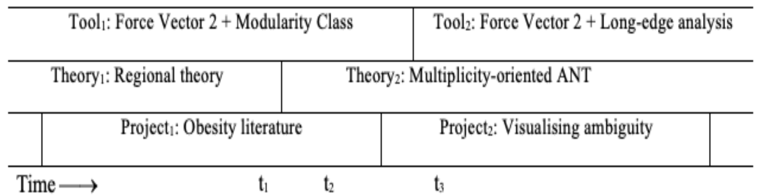


Figure 2: The intercalated development of tools and theory in TANTlab projects related to obesity.

[1] With this view, Galison positions himself in opposition to both positivists and anti-positivists. Positivists believe that physics has a growing continuous foundation of basic observations, which guarantees the continuity of the field despite changing theoretical interpretations. Anti-positivists believe that all observation is theory-laden and that paradigmatic theoretical change will therefore create simultaneous ruptures in observation and experimental practice.

## A digital project on obesogenic environments

The location of the case is the Techno-Anthropology lab (TANTlab) at the Copenhagen campus of Aalborg University. In a physical sense, TANTlab is a large room with a meeting table, a sofa area and a collection of digital equipment, including large screens and some Virtual Reality equipment. TANTlab is a digital methods lab founded in 2015 with the intent of creating a digital methods experimentation hub for the researchers in the Techno-Anthropology Research Group at Aalborg University as well as their external collaborators (Abildgaard et al. 2017). The lab is directed by Anders Kristian Munk, one of several participants who would describe themselves as STS researchers. The lab also includes people with considerable technical skills, such as Mathieu Jacomy, an engineer and software developer who has played a key role in developing several of the most widely used digital tools in STS. It should be noted, however, that the distinction between 'technical' and 'STS' is actively blurred in the lab. Many of the participants, including Munk and Jacomy, have put considerable effort into developing both technical competencies (including programming) and knowledge of the field of STS. Over the years, the TANTlab has hosted a stream of projects, seminars and events that have brought together STS researchers, technical developers and external collaborators. The lab is thus, at least potentially, a trading zone between STS communities, technical communities and others.

In 2015, the newly established TANTlab was approached by Astrid Jespersen, who was the leader of the Copenhagen Centre for Health Research in the Humanities (CoRe) at the University of Copenhagen. At that time, CoRe was part of an international, interdisciplinary research project on obesity, and they were keen to explore whether digital tools and resources might provide new ways to study and understand how particular constellations of environmental factors, such as sedentary lifestyles and highly processed nutrition-rich food, might cause specific populations to develop obesity. In the obesity literature, this is referred to as *obesogenic environments*.



TANTlab accepted the invitation, and, in November 2015, arranged an intensive three-day workshop[2] in which obesity researchers, digital STS researchers, social scientists and students from CoRe and TANTlab worked on the topic of obesogenic environments. Ahead of the workshop, large datasets were harvested from Facebook, Instagram and scientific article databases. The aim of the workshop was to visualise, frame and cut the data in various ways to produce viable data projects and perhaps even tentative conclusions. One subproject, which I will discuss here, worked with a dataset consisting of a large collection of frequently cited scientific articles. The subproject included people from CoRe, TANTlab, and Stanley Ulijaszek, a professor in nutritional anthropology from Oxford University. During the intensive days of the workshop and the more than two-year collaboration that followed, we discussed and analysed the datasets in several ways. We eventually published our results in an article in *Obesity Reviews* (Elgaard Jensen et al. 2019).

In the following, I will discuss three moments that occurred during the work with the obesity dataset. The moments are marked as t1, t2 and t3 in Figure 2. At t1, the participants used a standard tool to identify so-called discursive regions in the obesity literature. At t2, the participants gradually realised that the first use of the tools was associated with a style of theorising of which they were critical. Some workarounds and novel concepts were, therefore, developed to enable a shift to a different type of theorising, which could roughly be described as multiplicity-oriented ANT (Vikkelsø 2007). At t3, the obesity data was included as a test sample in a new project. This project continued the commitment to multiplicity-oriented ANT while attempting to develop new digital tools that would articulate ambiguities rather than regional commonalities in the data. In sum, the case depicts a process of continuities and shifts as the changing crowd of participants engaged with two sets of tools, two types of theoretical commitments and two different projects. Next, I will explore the trading zone work that unfolded at each of the moments (t1-t3).

[2] The workshop followed the so-called data sprint format (See Munk et al., 2019).

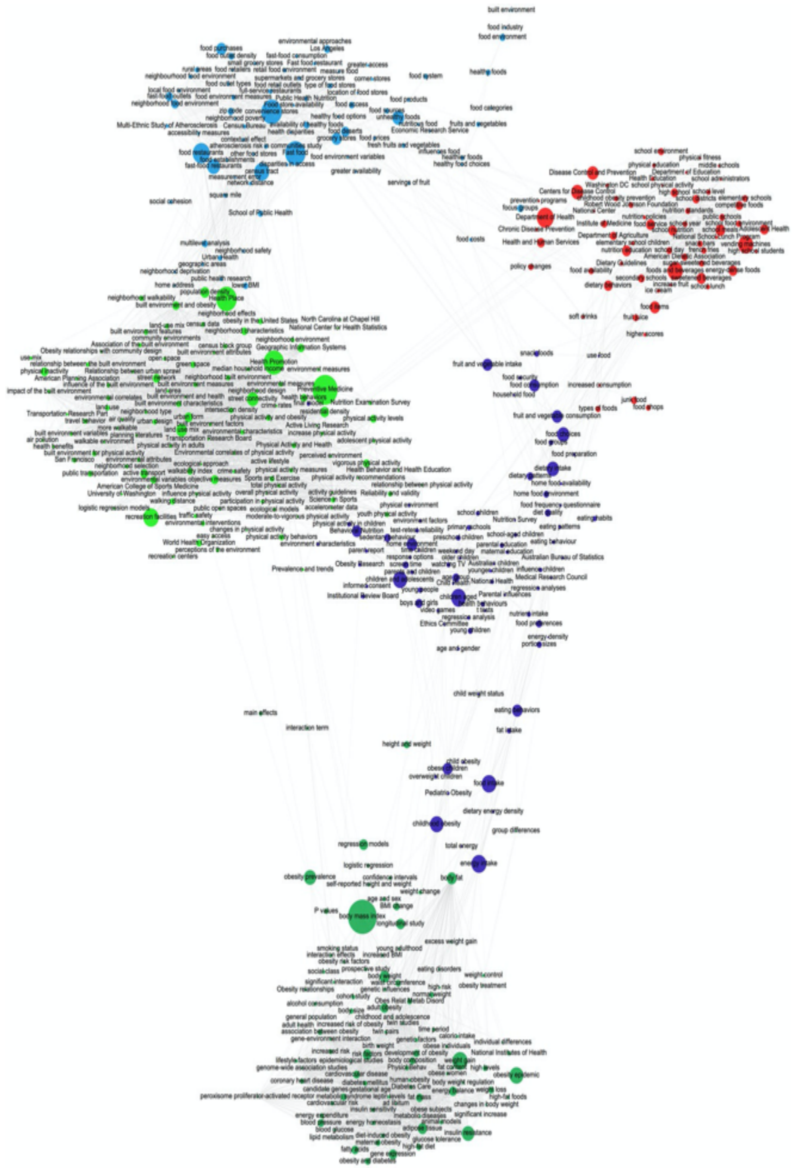

Figure 3: The map of five discursive regions published in *Obesity Reviews* (Elgaard Jensen et al. 2019).



## Identifying discursive regions (t1)

Figure 3 can be considered the first official analytical result of the project on obesity literature. The figure is a network graph published as a part of our *Obesity Reviews* article (Elgaard Jensen et al. 2019). In the article text, we explain that our aim is to unpack the notion of obesogenic environment in the scientific literature, and we argue that the figure shows five different discursive regions, indicating that *environment* is talked about in five different ways. We call these environments the institutional environment, the food environment, the built environment, the family environment, and the bodily environment.

To understand how we used particular digital tools to produce the network graph and the five types of environment, some further explanation of our production process is needed. As we explain in the *Obesity Reviews* article, the discursive regions were produced in the following way. First, we used the semantic analysis software, CorTexT, to extract key terms from the text corpus and generate a map of terms that co-occurred in the articles. Then, we exported the graph to the data visualisation software, Gephi (Bastian et al. 2009), where we performed two operations that each separated the network into parts. The first operation, called the ForceAtlas2 spatialization, ensures that nodes[3] connected by many edges are lumped together on the network graph, while nodes connected by fewer edges are drawn apart. The second operation, called the Modularity Class, performs what is known as community detection. The Modularity Class is based on an algorithm that calculates different ways of separating the network into parts. After a number of iterations, it selects the partition that cuts through as few edges as possible, and, finally, it gives each of the parts a separate colour. ForceAtlas2 and the Modularity Class work more or less in tandem; the

[3] The terms nodes and edges that I use here is standard terminology for mathematical graph theory. Nodes refer to the fundamental units of which a network is formed, whereas edges refer to the relationships between the fundamental units. In a network of friends, the nodes would thus be names of people, and the edges would be friendship relations that connect particular sets of people. On a network graph, a node is visually represented as dot or a small circle, whereas an edge is represented as a line between two nodes.

terms that are placed together in a cluster by ForceAtlas2 will often also be given the same colour by the Modularity Class.

The use of the digital tools in the obesity project worked well in the sense that they produced a map. The (trading zone) question, however, is how they connected, or were connected by us, given our STS theoretical sensibilities. To approach this question, it should be noted that spatialization and modularity tend to make a particular kind of data interpretation almost unavoidable. For instance, the obesity expert in the group, Ulijaszek, might look at Figure 3 and make the following point: *The dense red cluster to the right is the food environment*. In a straightforward sense, he would be completely right. There is a dense set of nodes brought there by the spatialization algorithm. All the nodes are red, coloured in this way by the modularity algorithm. This assemblage of red nodes was what we chose to call a discursive region, assuming that the 'thing' on the map constituted a particular discursive region.

The problem with this interpretation, however, is that it could easily be seen as a somewhat crude categorisation. It says nothing about *process*, even though the underlying data was articles published over a 15-year period, many of which cited each other. The designation of 'this' as 'a region' may also be seen as a *homogenising* move, suppressing all differences within the cluster and setting one cluster radically apart from the others. The potential criticism of the designation of regions that I am suggesting here is in line with STS analytical sensibilities––or similar social science perspectives that emphasise the processual, situated, contextualised, or practiced nature of social phenomena. To mention just one well-known example from the STS literature, Mol and Law (1994) characterise a broad range of traditional social science approaches as *regional*. In the regional mode of thinking, they say, 'objects are clustered together and boundaries are drawn round each cluster [...], neat divisions, no overlap. Here or there, each place is located at one side of a boundary' (Mol & Law 1994: 647). By contrast, actor-network theory and later developments of this approach attend to materially heterogenous relations, their tensions, their effects and how they change over time.

To the participants in the project, the critique of regionalism was well known[4], so we were interested in looking for ways to move beyond regional theorising, especially if this could be done without discarding all of the previous work and the maps.

## Shifting toward a non-regional style of theorising (t2)

The *Obesity Reviews* article, the written product of our work, can be seen as a strikingly heterogeneous affair. In the first four pages, the article reports the use of digital tools and algorithms, such as CortexT, Force Vector 2 and Modularity. Based on this, the article presents what it calls 'a map of five discursive regions' (Elgaard Jensen et al. 2019: 622). In the second part of the article, from page four onwards, the language shifts. Now, the entities on the map are no longer referred to as 'discursive regions' but as 'notions of environment'. On the final page of the article, the meaning of the map is described in language that clearly suggests complex movement and interrelations rather than a regional segregation: 'The field can be interpreted variously as being simultaneously integrating and disintegrating, a partially coherent hierarchy, and/or a pattern of simplification and complexification' (Elgaard Jensen et al. 2019: 628).

In the following, I will analyse the specific manoeuvres that made it possible to produce an article that both contained a regional map and a type of theorising that was distinctly non-regional. I trace these manoeuvres by following the sequence of arguments in the *Obesity Reviews* article. The first move away from the regional is made in the following way:

[4] This included our topical expert, who had recently published a paper on complexity directly inspired by John Law (Ulijaszek 2015).

> Each cluster in [Figure 4 in the present text] represents what we have termed a discursive region: a particular way of framing obesity as indicated by a tendency to use particular sets of terms. The aim of the qualitative analysis was to explicate these 'ways' or more precisely the underlying notions of obesogenic environment—the figures of thought that appear to guide the researcher's choice of how to frame and speak about their research objects. (Elgaard Jensen et al. 2019: 624)

What is introduced here is a distinction between surface and depth. The clusters on the surface of the map show the tendencies to use particular terms—the overt language behaviour, so to speak. However, behind each of these surface clusters, we—the authors—claim the existence of underlying 'figures of thought' or 'notions of obesogenic environment' that guide obesity researchers. In the next part of the text, the idea of underlying notions is further developed:

> To structure our qualitative analysis, we posited that any particular notion of [the] obesogenic environment could be characterized by describing three key elements: (a) the kinds of elements and processes that constitute the environment, (b) the kind of 'obesity object' that is believed to be contained and influenced by that environment, and (c) the presumed mechanisms of interaction between object and environment. This simple conceptualization was used both to guide our qualitative analysis and to summarize its results. (Elgaard Jensen et al. 2019: 624)

What is presented here can be seen as a mini-theory, a listing of three constitutive elements that define the notion of obesogenic environment. This mini-theory is not just an ontological claim; it is a device that allows us, the authors of the article, to approach the clusters on the map in a new way. In a *regional* mode of thinking, a cluster on the map consisting of, say, 50 terms must be treated as a bulk of language, where presumably all terms are equally interesting. Using this mini-theory of constitutive elements, we could allow ourselves to treat each cluster as a hunting ground. This facilitated a search within the cluster to find the three elements (obesity object, environment, interactive mechanisms) that we had defined as the notion of obesogenic environment. On finding these three elements, we could disregard the rest of the terms in the cluster unless they directly contradicted our findings. This style of analysis is practiced over the next two pages of the *Obesity Reviews* article, where we spell out the underlying notion of obesity behind each cluster. We describe, for instance, the *built environment* where the physical surroundings of humans (environmental elements) lead to more or less energy expenditure in daily life (interactive mechanisms), which, in turn, influences the population's body mass index (obesity object). We also describe the *bodily environment*, where the total functioning of the individual body (environmental elements) stimulates particular physiological processes and types of gene expression (interactive mechanisms) that, in turn, lead to more or less fat deposition in the human or rodent organism (obesity object).

The depiction of underlying notions as indicated above was one step away from a regional style of thinking. The next series of moves in the article brings it further towards a type of theorising that is roundly inspired by ANT or multiplicity-oriented ANT. In the discussion section (ibid: 627-8), we venture into commenting on the current configuration of the entire field of obesity research. To launch our commentary, we introduce a particular government report that Ulijaszek had pointed out as a very important voice in the field. The report, which we would later draw into question, is the widely known and widely recognised Foresight report published by the United Kingdom's Office for Science (McPherson et al. 2007). The Foresight report, we allege, is founded on the normative idea that the entire field of obesity research should become as coordinated and coherent as possible and that the different parts of obesity research should be built into one grand system model that will summarise the totality of factors contributing to the current obesity epidemic in the population.

After introducing the position of the Foresight report, we continue the article by making a series of critical comments. First, we point out that the spatial distribution of clusters on the map (Force Vector 2 algorithm) appears to show two things at once. Parts of the field may have relatively close overlaps, especially the notions of institutional, built, food and family environments. At the same time, the cluster of bodily environments seems to be quite unrelated to the others. This is not what the Foresight report would have expected or wanted to happen. In a second critical move, we revisit the list of different obesity-related objects that we identified behind each of the clusters. These obesity-related objects include obesity in adolescents and children, the institutional food services, and the deposition of fat tissue. We argue that the objects that lie at the heart of the five clusters 'do not add up to a single well-defined and well-described system'. 'Instead, the five clusters overlap, interpenetrate, and leave gaps' (Elgaard Jensen et al. 2019: 628). With this argument, we again question the systemic ambitions and assumptions of the Foresight report and like-minded attempts to develop systemic models for the field. In a final stab, we offer an alternative explanation of the field. In what might be read as echoing constructionist approaches in STS (Knorr-Cetina 1995), we argue that each notion of obesity appears to be organised around a particular set of convenient simplifying assumptions, available instruments, and pragmatic opportunities to study obesity-related phenomena[5]. The measure of BMI as an indicator of obesity is one example; the use of rodents as model organisms in laboratory work is another. With this argument, we again question the Foresight report's assumption that the field can and will come together in a one-system model. Instead, we convey a view of multiple ontologies and partially connected practices. By the end of the article, we have thus made a full move away from regional theorising and towards ontological assumptions similar to the ones found in performative versions of STS (Law 2004). Thus, a shift in theory has happened without discarding the map or the digital tools upon which the map was based.

I have now sketched the arguments that we developed and have shown how these led us to a distinctly non-regional style of theorising toward the end of the article. Let me end this part of the account by pointing out two types of trading zone moves that enabled the somewhat unlikely connection of a regional map with a non-regional theory.

The first type of trading zone move could be called the introduction of *assisting background ontologies*. By this, I mean ontologies that do not question what the map shows, but rather add to it in a way that allows the map to be connected to a new theory. We have seen two examples: 1) the claim that, *behind* the clusters, one can find underlying notions of environment and 2) the claim that, *before* the formation of the clusters, there was a process of finding convenient simplifications and instruments.

The second type of trading zone move is the introduction of a *project-specific problem* that sets up a local success criterion for what the combination of a tool and a theory should achieve. In our case, we argue that the field is dominated by the mainstream view of the Foresight report. Following this, a variety of tool+theory combinations could be seen as relevant contributions to the project because they either question some aspect of the mainstream or suggest an alternative. In our case, we claim that our mapping of five relatively incommensurable notions of obesity draws the holistic ambitions of the Foresight report into question.

As we shall see later, both the introduction of assisting ontologies and the setting up of project-specific problems were moves that we would repeat as we continued to work with the obesity data in a new project.

[5] Recently, Ulijaszek (2020) used this argument in a commentary on productive simplifications and dependency on particular convenient research tools in the field of malnutrition research.

## Developing new tools (t3)

The uneasiness about the Modularity Class algorithm was not only felt in the obesity project. There were concerns in several other projects at TANTlab that Modularity Class and other digital tools might have a tendency to produce data visualisations that were too regional, neat, homogenous and simple. To borrow a phrase from John Law, our worry was that complex matters would be distorted into clarity (Law 2004). TANTlab decided to organise a workshop for the purpose of developing digital tools for visualising ambiguity. The workshop was hosted by TANTlab in 2017 in collaboration with an invited group of data visualisation experts from Density Design from Milan. Among the participants were digital methods researchers from ETHOS Lab, ITU and software developers from Médialab, Sciences Po.

The Visualising Ambiguity workshop had several working groups, and I will describe the digital tool development that took place in the working group in which I participated. My reason for this focus is that this working group can be seen as a kind of sequel to the obesity project. Not only did the working group take the uneasiness about the Modularity algorithm as its starting point, it also decided to use the obesity data as its test case and to give me the task of evaluating whether the new tools developed by the group would bring out interesting forms of ambiguity that were absent in the obesity project.

The working group had the benefit of including Mathieu Jacomy, a chief developer of Gephi, who had detailed knowledge of the workings of the modularity algorithm and its implementation in Gephi. At the beginning of the workshop, Jacomy explained to us that the Modularity algorithm is not a deterministic procedure; it merely produces an *approximation* of the best way to separate a network into parts. For this reason, an element that is at the border of two clusters may end up in one cluster on one occasion and in the adjacent cluster on another. The group found this flickering between adjacent clusters to be a very interesting type of ambiguity. We therefore set up an experiment where we ran the algorithm several times, each time with slightly different starting parameters. Through this, we identified a small number of "flickering elements", i.e. elements that the algorithm placed in different colour-coded clusters on different ocassions.

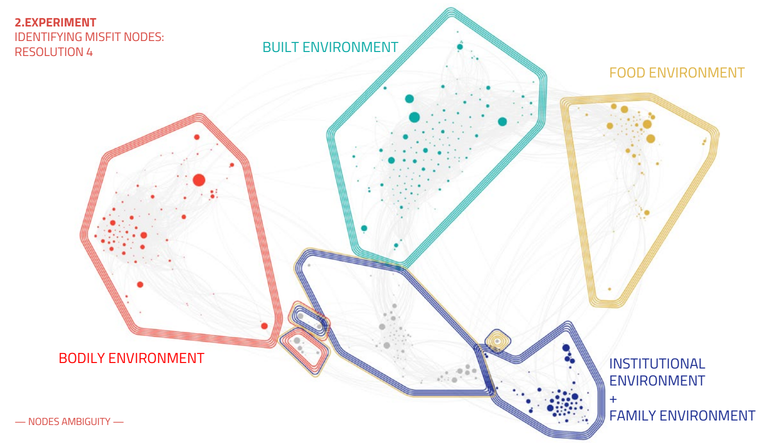


Figure 4: A visualization of the ambiguity of regions produced by the Modularity algorithm. The coloured curves show the clustering of nodes suggested by the algorithm on number of consecutive runs. The figure shows that a small number of nodes are 'encapsulated' in curves of different colour, indicating that their belonging to a particular cluster is ambiguous. (Data sprint on Visualising Ambiguity, TANTlab, December 2017).

Another take on ambiguity was developed by contemplating the map (see Figure 3). As I have previously discussed, the most obvious features of the map are its 'regions'. However, despite the work of the spatialization algorithm, which clustered entities into regions, the map also showed a number of edges (lines) that connected terms firmly located in one cluster with terms that were firmly located in another cluster. The edges were, so to speak, indicating connections from the core of one cluster to another; in this way, the edges were indicating relationships that were exceptions from the assumption that entities could be sorted into regions. We nicknamed these edges the long edges because they connected entities that were located in different clusters and, hence, were far apart on the map. To bring focus to these long edges, Jacomy wrote a small programme that generated a list of the pairs of entities that were connected *across* the discursive regions.

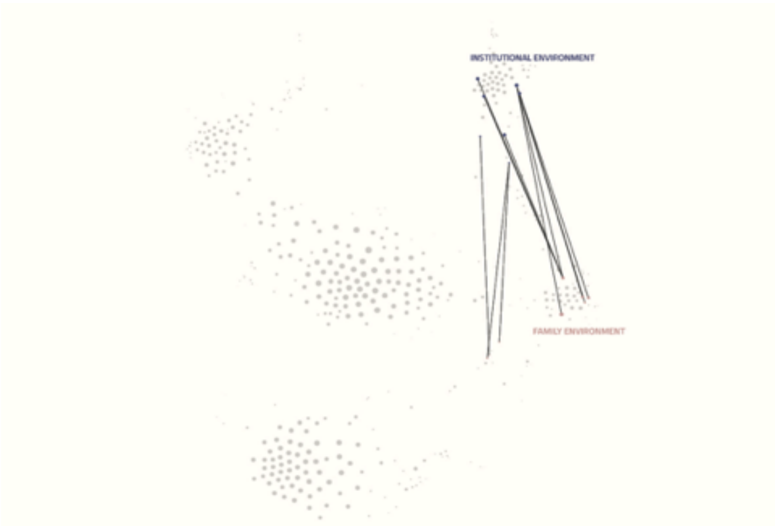


Figure 5. A visualisation emphasising the long edges that connect different discursive regions. In this visualisation, the discursive regions are made to recede into the background, thus reversing the figure-ground compared to Figure 3 (Data sprint on Visualising Ambiguity, TANTlab, December 2017).

In sum, we had two new ways of visualising ambiguity. We could focus on elements that were flickering back and forth between neighbouring clusters, or we could focus on the long edges connecting one discursive region with another.

Since I had previously worked with the dataset, I was asked to interpret the meaning and potential value of these novel visualisations. Upon closer inspection, my assessment was that the flickering terms were relatively uninteresting. They were often broadly used terms, such as food intake or child obesity, and their flickering between clusters was therefore not very surprising. However, the long edges that connected clusters seemed to elucidate something of potential value. In the case of the obesity material, the terms appeared to give interesting hints as to what might be shared between two clusters. These shared things were sometimes an attachment to a particular policy area, such as preventive medicine or public health nutrition. In other cases, there was a shared relation to particular institutions, such as the Department of



Agriculture or Ethics Committees. In still other cases, the shared entities were particular kinds of research devices, such as twin studies, census data, the walkability index or BMI. All of these were promising leads, which might stimulate further inquiries into our collection of obesity articles if we were to conduct a follow-up analysis of the material in a future project[6].

In the context of the methods-oriented Visualising Ambiguity workshop, we concluded that long-edge analysis appeared to be a fairly simple but promising tool. Its particular merit would be to bring out the texture of relations that interconnect the parts of a field that from, another perspective, might be seen as separated regions. We also noted that this style of analysis would have affinities with some classic studies in so-called multiplicity-oriented ANT, such as Annemarie Mol's (2002) account of the internal connections between partially disconnected enactments of a disease or John Law's (2002) account of the multiple interfering versions of an aircraft. The long-edge tool was subsequently made publicly available on the open source repository, Github.

The development of the long-edge analysis, which I approved, and the development of the flickering node analysis, which I discarded, were both outcomes of encounters in a trading zone. Next, I will try to explicate the moves that made these products possible.

In the Visualising Ambiguity workshop, the work of the group revolved around the use of the obesity dataset and my role as the evaluator of whether a particular visualisation would offer a new and interesting kind of ambiguity. There is a rough equivalent between this social arrangement and the anthropological studies of trading that inspired Galison (1997: 831-833) to adopt the notion of a trading zone. When meeting a foreign group and offering them some kind of good, the crucial thing is not to fully understand why they are buying it—all you really need to know is *whether* they will buy it. In much the same way, the software developers and data visualisation experts in the group did not necessarily need to fully understand my entire

[6] Unfortunately, it has not been possible to gather participants or momentum for a second round of analysis of the obesity material.

reasoning for 'buying' or 'not buying' a particular type of visualisation. What mattered, pragmatically, was that I could give them a fairly clear and fairly immediate answer. If we turn back to the first obesity project, similar social arrangements were in place. In that project, Ulijaszek, the professor in nutritional anthropology, could immediately tell the rest of us if our mapping of the field contributed anything that could challenge or qualify the mainstream view of the Foresight report. Again, this immediate access to a project-specific evaluation scheme allowed us to quickly sort between valuable and less valuable connections between digital tools, theoretical comments and specific success criteria of the project at hand.

In addition to the introduction of project-specific criteria, the working group also deployed a trading zone move that I have called the introduction of assisting ontologies. In the terms of the semantic analysis software, CorTexT, a long edge is nothing more and nothing less than a representation of the fact that two specific terms tended to occur in the same articles in the obesity dataset. However, in the working group, we added a series of additional ontologies. We talked about the long edges as 'shared things', which we then exemplified as 'shared attachment to policy areas', 'shared relations to institutions', or 'shared engagement with research devices'. All of these ontologies provided further possible points of connection between the long-edge visualisation, the theoretical commitments of the group and specific questions that might be interesting for the obesity project. In this way, yet another set of little connections was made between theory and tools, allowing the further extension of the threads of digital STS.

## Discussion: Trading zones and the development of digital STS

In this article, I have drawn on Galison's notion of a trading zone to explore the data and knowledge practices of a part of digital STS that has a deep investment in digital tools. As I have shown, the intercalated



view of physics history suggested by Galison also appears to be an apt description of this part of digital STS. In the case described in this article, the tools, theories and projects were developed together, but they clearly did not march in lockstep. Consistent with Galison's intercalated periodisation of physics, there are continuities, as well as ruptures, every step of the way. The participants in the obesity project held onto the same set of digital tools while shifting theoretical commitments. The participants in the Visualising Ambiguity workshop held onto the same theoretical commitments while developing a different set of digital tools.

The shifting connections between tools, theory and projects are indicative of the trading zone work that took place. In my examination of this trading zone work, I have emphasised two specific strategies used by the participants. In what remains of this article, I will revisit these strategies and discuss what they might suggest about the current and future development of the field of digital STS.

The first strategy was the introduction of *assisting ontologies*. This kind of move is typically made by STS theorists in response to the objects offered by digital tools and their developers. In this mode, theorists introduce 'underlying notions of environment' to make better sense of colour-coded regions, or they introduce 'shared attachment to policy areas' to make better sense of the co-occurrence of specific terms. What this suggests, at the very least, is that the current digital tools rarely deliver something that is easily and directly compatible with the theoretical sensibilities of STS. An effort on behalf of the STS theorist is thus required. The process can perhaps be described as the art of 'seeing something as something else' (Asplund 1970). For connections to be made, the STS researcher must figure out a way to see the digitally produced object in different terms than those of the tool maker. Perhaps the digital object is a reflection of an underlying process? Or perhaps the object is an element in a larger structure? The kind of creative analytical move required is akin to how other STS scholars have innovated the way we see particular objects. To mention a few grand examples, Latour and Woolgar (1979) invited us to see a laboratory as a factory of literary inscription, Pinch and Bijker (1984) invited us to see a bicycle as a social struggle, Mol and Law (1994) invited us to see a medical condition as a set of social topologies, and Haraway (2003) invited us to see a dog as a companion species. If seeing something as something else is the kind of work that theoretical participants in digital STS projects must undertake, then it is highly unlikely that engagement with digital tools will develop into a specialised or limited version of STS. On the contrary, the ability to trade with digital tool makers appears to depend on the ability to draw broadly on the theoretical sensibilities of STS[7].

The second strategy, or type of trading zone work, was the introduction of *project-specific problems*. As I have argued, the trick is to set up a local success criterion against which possible combinations of theories and tools can immediately be evaluated. In the obesity project, Ulijaszek could tell us straight away if we had found something that was not in the Foresight report, while, in the Visualising Ambiguity workshop, I could quickly tell my collaborators if they had articulated a type of ambiguity that would add something interesting to the previous project. This strategy of including third parties or issue experts into the trading between digital tool developers and STS researchers is not specific to the projects discussed in this article. The idea of inviting issue experts into the so-called the engine room is a defining feature of the data sprint approach that TANTlab and several other labs have developed and pursued in the past five years (Munk et al. 2019).

In a broad sense, this kind of tri-partite trading zone work can be viewed as an example of an even broader development in STS toward a more engaged and interventionist mode of knowledge production (Sismondo 2008; Zuiderent-Jerak 2015). In recent years, this interventionist movement has been given further impetus by the efforts of Teun Zuiderent-Jerak and Gary Downey (2020) to articulate, enable and cultivate a style of STS research that they call making and doing.

[7] Vertesi and Ribes (2019) make a similar but broader argument, claiming that all parts of the emerging field of digital STS—regardless of whether they are equipped with digital tools—are drawing on a broad spectrum of STS sensibilities.



Zuiderent-Jerak and Downey (2020) point out that, since its beginning as a field, STS has criticised linear notions of knowledge production. The making and doing, they argue, is a way of turning that essential STS lesson onto the field itself. Zuiderent-Jerak and Downey (2020) characterise and define the making and doing movement in a number of ways; its scholarship moves beyond the academic text, it translates STS knowledge into forms that can be fitted or attached to empirical fields, it learns reflexively from its collaborators and it willingly runs the risk of producing knowledge that travels in new ways. All of these characteristics match the trading zone work and the projects that I have described in this article. They move beyond the standard academic text, they fit STS knowledge to specific fields and they disseminate their products through new networks of collaboration. However, the characteristics also match a broad variety of other contemporary STS projects, including meta-activism projects, projects that deliberately challenge academic boundaries and a range of participatory projects (Zuiderent-Jerak and Downey 2020). In my view, these new types of scholarship—and the making and doing STS movement in general—will be valuable companions and conversation partners for digital STS in the future[8]. This could yet be another way in which digital STS may continue to draw on the strength and the sensibilities of STS as it enters into trading zones with other communities.

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[8] For discussion of a series of TANTlab projects in the context of interventionist STS scholarship see Elgaard Jensen et al. (2020).

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# Commentary: Why (and how to) experiment with digital social data?

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## Abstract

Adopting Noortje Marres' important book on *Digital Sociology* as its main interlocutor, this commentary critically discusses the widespread (re-)turn to the practice and rhetoric of experimentation in the realm of digital social data, big or otherwise, drawing, in part, on personal, collaborative research experiences. In doing so, the commentary positions science and technology studies (STS) as both a valuable resource for such reflection *and* a partisan participant in wider on-going epistemic struggles and re-alignments in the digital realm. In particular, I deploy long-standing STS resources to discuss certain well-known ambiguities around 'the experiment' as a genre or device of knowledge-making, and explore how such ambiguities play out in contemporary discussions over, and aspirations for, so-cial research based on digital data. Here, while deeply sympathetic to Marres' and allied STS-based projects for digital research, the commentary also questions some of the slippages and demarcations enacted by its circumscribed re-casting of *experimental* practice. These slippages, I will show, entail their own unwarranted universalization of what it means to do intervention and, by implication, experimental intervention as part of the practice of STS-informed digital research. As an alternative, I suggest that STS may want to reflect further on, and eventually differentiate more carefully between, various deployments of the practice and rhetoric of digital experimentation, including its own, to more precisely render their divergent conditions and possibilities of epistemic felicity. In doing so, however, I will *also* suggest that, for all its plural manifestations, STS would do well to revisit earlier pragmatist arguments by, in particular, John Dewey, in order to fully appreciate what the commentary calls the meta-experimental promise of digital social research.

**Keywords**: digital data; experimentation; intervention; pragmatism; STS-informed digital research



The advent of big, digital, and otherwise purportedly new social data formats is accompanied everywhere across (and beyond) the social sciences by a resurgence in the practice and rhetoric of experimentation. One need only consult the journal Big Data & Society to see the words 'experiment' and 'experimenting' included in the titles of several recent articles, including one co-authored by myself (e.g. Ziewitz 2017; Blok et al. 2017; Madsen & Munk 2019). As this suggests, I arrive at this commentary's title and questions as a matter of practical urgency, having been involved over recent years in a large-scale interdisciplinary research collaboration known as the Copenhagen Networks Study (CNS), in which we similarly extoll the language of experimentation. However, and as I expand upon a little later, we do so in the CNS setting in rather different, and indeed somewhat incommensurate, ways, thereby provoking an awareness, as a research community, of the need for further interrogation and clarification of the stakes of a digital-experimental ethos.

In an important contribution along exactly these lines, and one that I adopt here as my main interlocutor throughout, science and technology studies (STS) scholar Noortje Marres both evinces and discusses such a widespread (re-)turn to experimenting with digital social data in her recent book *Digital Sociology*. Here, Marres suggests (2017: 98ff) that claims to experimentalism in digital research come in both generic and specific senses. At the generic level, digital sociology is by necessity experimental, she argues, in the sense of being committed to trying out new and hence relatively unfamiliar methods and techniques, at least as far as the social sciences go. In the language of Adrian Mackenzie and colleagues (2015: 367), digital sociology makes use of new "skills and tools, borrowed and copied from domains of statistics, software development, hacking, graphic design, audio, video, and photographic recording and predictive modelling––that is, from the media-textual environments of contemporary culture themselves".

In a more specific sense of the experiment borrowed from the history of science, however, Marres (2017: 98) suggests that whereas "sociological research tends to rely on descriptive and observational data, recent work in digital sociology stands out for its interventionist approach". This distinction echoes the language of philosopher Ian Hacking (1983; 1992): whereas some sciences develop 'styles of reasoning' based on models, comparisons, statistics or other forms of *representation*, what Hacking calls the laboratory style, introduced in the mid-17th century, are sciences that *intervene* in the phenomena they seek to understand. Indeed, the ability to test a hypothesis or to explore new phenomena in an isolated setting by way of manipulating and controlling the conditions and processes to which the object of knowledge is subjected, has long defined the idea and ideal of the contained, controlled experiment of the *natural-physical* sciences. Correspondingly, it has long fed conversations around the philosophy and practice of the *social* sciences, either as an ideal to emulate or as a critical counterpoint for alternative conceptions of knowledge (see, for recent STS contributions, Guggenheim 2012; Lezaun et al. 2013; Zuiderant-Jerak 2015).

In this commentary, then, I want to explore and discuss how well-known ambiguities around 'the experiment' as a genre or device of knowledge-making play out in discussions over, and aspirations for, social research based on digital data. Taking Marres' work as prompt, I argue that STS is both a valuable resource for such reflection *and* a partisan participant to wider on-going epistemic struggles and re-alignments in the digital realm, with its own stakes and with clear real-world implications. Here, while deeply sympathetic to Marres' (and allied) STS-based projects for digital research, I want also to question some of the slippages and demarcations enacted by their circumscribed re-casting of experimental practice. These slippages, I show, entail their own unwarranted universalization of what it means to do intervention and, by implication, *experimental* intervention as part of the practice of STS-informed digital research.

This, in turn, puts the onus on my own practical-conceptual stakes in digital experimentation. Here, based in part on CNS experiences, my argument is twofold. First, reminiscent of kindred critical reflections around 'the laboratory' as (also) a metaphorical form (e.g. Guggenheim 2012), I suggest that STS may want to reflect further on and eventually differentiate more carefully between various deployments of the practice and rhetoric of digital experimentation, including its own, to render their divergent conditions and possibilities of epistemic felicity more precise. Second, however, I *also* suggest that, for all its plural manifestations, we would do well to revist earlier pragmatist arguments, particulalry by John Dewey (1938), to fully appreciate what I call the meta-experimental promise of digital social research.[1] In other words, I argue that Dewey's notion of experimental social inquiry helps us to tease out family resemblances between, and conditions of compatibility between, practices and devices of digital experimentation that are otherwise divergent from, and even sometimes cast as antagonistic to, each other.

This meta-experimental play of divergence, (in-)compability, and family resemblances carry direct import not least for the two genres of digital social research known respectively as computational social science and digital methods (see Veltri 2019). Hence, in making her STS-based claims around interventionist digital methods, Marres (2007) is very much aware how experimental ideals nowadays *also* influence many emerging practices in computational social science; a promissory research frontier shaped in equal measure by physicists turned human network analysts as by the more 'behavioural' parts of the social sciences (Lazer et al. 2009). In this sense, she actively partakes in new lines of articulation and demarcation, somewhat resonant with how experiments shaped epistemic struggles across psychology, economics, and parts of political science and sociology throughout the 20th century (Savransky 2016). Specifically, Marres is at pains to ward off her own digital sociology from other experimental influences. The aim of digital sociology, she asserts (2017: 102), "is *not* to mimic methodologies derived from scientific disciplines and to conduct the

[1] My choice in this context to invoke Dewey rather than his fellow and equally experiment-friendly early pragmatists, Charles Sanders Peirce and William James, stems from Dewey's (1938) more explicit articulation of the general import of experimental practices and principles for *social* as opposed to natural-physical inquiry

‘controlled experiments’ that laboratory science is known for”. Instead, the goal is to test “the *partly unknown* methodological capacities of digital infrastructures, devices and practices to inform and advance social research”. Towards such an aim, Marres suggests, controlled social-scientific experiments conducted in online environments will have little to contribute.

By implication, Marres’ sense of what an interventionist approach entails differs markedly from the standard idea of the controlled experiment. She evokes the Chicago School tradition of sociological fieldwork, which framed existing social environments as themselves ‘laboratories’ that served to magnify and bring into focus specific social questions (Gieryn 2006). Amidst digital cultures bent on proliferating data trials––from self-monitoring and living labs to political data leaks and various sorts of digital publics––social scientists will have many opportunities, Marres suggests, for latching themselves onto and adapting such ongoing ‘real-world’ digital experiments for the purposes of social inquiry. In doing so, they can also try out new and more ‘interactive’ and participatory ways of relating methods, data, and research sites––such as using a Twittter bot to solicit and generate research material, or deploying Facebook network visualizations as narrative devices during interviews. Here, social inquiry comes to (re-)deploy a range of digital 'interface methods' (Marres & Gerlitz 2015), born and bred across platforms and disciplines, in as-yet unfamiliar, non-conventionalized, and in that sense ‘experimental’, trial-and-error-like ways.

## Expanding, delimiting, or differentiating experimentalism in digital social research?

This agenda is important and worthwhile, in that it is largely co-extensive with various new and promising digital social research methods that have beem forged over the past 10 to 15 years. Moreover, as noted, the wider field of STS research has itself played, and continues to play, a pivotal role in these developments as it expands its own repertoire of



intervention practices (see Lezaun et al. 2016). Still, I want to suggest that Marres’ core conceptual manoeuvre, one redoubled in much allied digital and/or interventionist STS work (e.g. Zuiderant-Jerak 2015; Ziewitz 2017; Madsen & Munk 2019), relies on an under-justified bifurcation, of ‘conventional’ from ‘non-conventional’ senses of the experiment, when in fact the territories of experimentalism inherited from the history of science are potentially more ambiguous and interesting. Hence, whereas STS work like Marres’ contributes to an ever-more expansive *conceptual* account of experimentation as a multivalent and rather unbounded genre or device of elicitation increasingly at work across the sciences, arts, economy and public life (Lezaun et al. 2016), it *also* serves to delimit how versions of this genre get deployed as *practical* resource (rather than topic) for STS research, based on less-than-obvious philosophy of science ideas (to which I return later on).

In particular, Marres’ (and allied) invocations of experimentalism-as-(digital-)STS-resource may be said, I believe, to (still) echo a wider epistemic configuration stabilized, as Guggenheim shows (2012), in post-war social science. Here, sociologists of quantitative and qualitative persuasions alike would come to accept ‘standard’ philosophy-of-science accounts of controlled laboratory experiments as co-extensive with experimentalism writ large, all the while marking these out as mostly irrelevant to sociology. This is essentially the configuration that Marres now maps onto computational social science, marking this out as irrelevant to her own digital sociology. Meanwhile, the quite contrary (‘non-conventional’) sense of experimentalism *embraced* by Marres (and allies) is one in which, it seems to me, ‘intervention’ is given such a broad and non-circumscribed sense as to make its relation to the epistemic goals of any experimental style of reasoning somewhat strained. Here, following Hacking as well as recent STS work on social-psychological experiments (Lezaun et al. 2013), I take that style as defined by the aspiration to closely observe an object of study under conditions of its (partial) manipulability and (partial) containment, with a view to enacting (or provoking) that object in a particularly vivid, surprising, and indeed realistic version.[2]

Hence, in short, it seems to me that Marres' commitment to interventionist digital research practices is experimentally underspecified, so to speak, to the point of risking co-extensiveness with the sense in which *all* social science practice can be seen to *inevitably* intervene in their surrounding socio-technical environments. The social sciences, as much STS has argued, are performative of socio-technical realities (e.g. Law 2009). Tellingly, in the history of social science reflection, such 'interventionist' insight is associated more strongly with hermeneutic-interpretative and constructivist sensibilities than it is with those 'post-positivist' positions for which the natural-physical experiment continues to be a gold standard for the social sciences, even when only practicable in the shape of naturally occurring 'quasi-experiments' (Kirk 1995). After all, the 'quasi-' part of social sciences' quasi-experiments refers to the *lack* of intervening capacity on the part of the researcher when it comes to assigning experimental controls on subjects (Guggenheim 2012: 108). This, of course, is another instance of the 'standard' philosophy-of-science configuration.

Downplayed here, I believe, is a more minor and more ambivalent tradition, allied to a slightly different version of the pragmatist Chicago School also invoked by Marres, where researchers found rather more compatibility (but not sameness) between certain versions of laboratory experiments and the interpretative aims of qualitative, fieldbased social science. As Guggenheim argues (2012: 108), for ethnomethodologists like Garfinkel and Cicourel in the 1960s, social sciences' laboratory experiments could be made to serve broader interpretive aims, in so far as they aimed to test the foundations of the reciprocal relations between experimenter and subject rather than take their common

[2] The famous post-second world war experiments in social psychology that Lezaun et al. (2013) analyse in terms of 'provocative containment' explicitly followed a controlled experimental format, with some becoming (in-)famous for the ethical controversies they sparked (and for good reason, I would add). Moreover, Lezaun et al. perhaps downplay the way controlled social-science experiments, also beyond social psychology, have been continuously challenged on epistemic grounds, in terms of the kinds of insights they actually warrant (Savransky 2016; Martin 2016)



assumptions for granted. Moreover, famously, Garfinkel would himself conduct so-called 'breaching experiments' on the social order, based on staging more-or-less artificial interactional situations as an "aid to a sluggish imagination" otherwise prone to taken-for-granted views of social life (see Ziewitz 2017: 4). It is this rather more ambivalent and pluralist territory of different-but-compatible social-science experimental registers that I believe could be revived, to good effect, in digital online environments and around digital social data.

Against this more fully recounted version of the history of (social) science, it is also meaningful, by extension, to ask why Marres, and the STS program she articulates, does not search for ways of appreciating more controlled forms of online experimentation on her *own* interventionist terms. After all, some such experiments––of which the 2012 study by Robert Bond and colleagues on social influence and political mobilization among 61 million Facebook users can be taken as example––might themselves be seen as social interventions whose discussion, and indeed ethical critique, may provide valuable insights into digital culture. This is the point made by Danah Boyd (2016) in the aftermath of the much-discussed 2014 Facebook 'emotional contagion' study: irrespective of the validity or otherwise of the study's findings, the discussion *surrounding* the study served to register wider and important questions of public accountability and discomfort with big data. Here, echoing Lezaun et al.'s (2013: 284) point about Milgram's (in-)famous 'obedience to authority' experiment, it certainly seems interesting for STS to analyse, and also to (experimentally) interfere with, the question of what exactly such online experiments enact.

The point of such appreciation, obviously, would not be for social-science researchers to endorse or indeed to participate in the kind of data extraction practiced by Facebook and other instances of 'surveillance capitalism' (Zuboff 2018), nor the way these companies invoke experimental commitments. Rather, to foreshadow my subsequent discussion of Dewey a little, it would be better to cast such an endeavour as committed to turning the question of what exactly 'surveillance capitalism' *is* and does into a matter (also) to be (co-)experimented with by STS research. Analogous to Garfinkel and Cicourel, for instance, one might imagine digital research designs inspired either by (relative) containment or by staged breaching that would make the very relation between Facebook and its users, including its corporate-experimental form, the subject of careful probing beyond common assumptions (to which I would count the very idea of 'surveillance capitalism'). Work such as Phillip Brooker's (2019)––on twitter bots as hovering in-between moral panic and playful public engagement––gives some indication of what this might mean in practice.

## Divergent digital-experimental registers: in search of productive confluences

Based on such reflections, I want, in what remains of this commentary, to suggest that there is value in more committed and mutually attuned critical-constructive conversations across these various and oftentimes incompatible styles of experimental social data practices, *all* of which are currently flourishing. As Marres' discussion serves valuably (if perhaps inadvertently) to highlight, there is at present little clarity––let alone agreement––as to the attendant issues of methodology, epistemology, and research ethics that arise in our present 'experimental moment' of social ('big') data. Moreover, as a reflexive endeavour itself, it seems to me that STS is both a valuable resource for more committed meta-experimental inquiry into digital social-science methodology and would stand to benefit from rendering its own digital-experimental resources more precisely defined vis-à-vis the history of social sciences.

These possibilities are already reflected, I would suggest, at the level of how the history, sociology, and philosophy of the *natural* sciences, STS included, contain within themselves not one but rather a range of possible analogies for digital social researchers, such as, for example, distinguishing laboratory from field-science styles of experimentation (Hacking 1992; Rheinberger 1994). It is also true, when broadening the scope of discussion further, that the experimental genre may be seen to engage social data in wider issues of the ethics, politics, and aesthetics of social research. This is registered in such terms as 'experiments in living' (e.g. Marres 2012), 'the experimental society' (e.g. Haworth 1960) and 'experiments in genre-crossing' (e.g. Kaiser 2012), for instance, to name some important ones. These are all relevant strands of conversation within digital social data research capacities, I would suggest, yet arguably they are still not sufficiently articulated vis-à-vis the epistemic aspirations of digital STS-as-experimentation.

One case in point is the otherwise excellent and highly interesting report by Madsen & Munk (2019) on their attempts to render a specific data-public visible as part of Danish school reform controversies by way of deploying STS-informed digital methods. While the authors talk about these efforts as 'an experiment', whether and how this experiment pertains to attendant conceptual issues (what is a public?); to specific digital-method affordances (what can in-situ data visualizations do?); to a wider sense of experimental policy learning (how can criticism be rendered relevant to power?); or, likely, to some combination of these epistemic aspirations is never quite clarified. What is problematic here, to be clear, is not the confluence of such related-but-divergent aspirations––quite the contrary, as I will argue using Dewey later on––but rather the lack of methodological specificity on what exactly would count as their various conditions of felicity, alone and together.

I arrive at these suggestions as a co-accomplice, rather than from some position of imagined distance. In the Copenhagen Centre for Social Data Science (SODAS) and the Critical Algorithms Lab (CALL) of anthropologists, sociologists, and STS researchers that I co-founded in this setting, we attempt to address such questions equally as matters of practical day-to-day research and as profound epistemological, ethical, and aesthetic challenges. Over the past years, as noted, we have worked with physicists, economists, psychologists, health scientists, philosophers and computer scientists on the CNS social data science project (known also as Social Fabric or Sensible DTU). This project deployed tailor-made smartphones as 'socio-meters' to map out the dynamic social networks of an entire freshman class of engineering students (N=800), whilst embedding an anthropologist within the cohort for a full year of participant observation. A range of insights have been generated from this confluence of data sources, including on spatial mobility patterns, study group performance, and party sociality, amongst others.

What has become obvious from this experience, as evinced also in previous publications (Blok et al. 2017; Kristensen et al. 2017), is that collaborative data-dense projects such as ours are indeed likely to be 'experimental' in several disjunctive senses all at once. In other words, they are likely to involve overlapping yet non-identical modalities of experimenting both *with* and *on* digital data, as resource *and* topic, in order to clarify their affordances for social research (Bornakke 2017). Specifically, to illustrate this duality, our data setting was meticulously configured such that it would conform to controlled experiment-like norms of (quasi-)random assignment of participating students into study-start groups ("RUS-grupper"), allowing our economist friends, in particular, some causal leverage on 'peer effects' later on (according to their paradigmatic language). Meanwhile, in the CALL setting, we have occupied ourselves mostly with deploying the *same* data to quite *different* method-experimental effects, mostly to do with questions of how one might leverage and stitch together time-space granular digital trace data and ethnographic observations in ways that push at the limits of *both* data practices in transversal ways (Madsen et al. 2018).

Again, such a confluence of experimental impulses is not unlike existing practices in some branches of the natural sciences, such as when animal behaviour researchers mobilize field experiments in ways that "take researchers into the animals' world to find out what matters to them" (Candea 2013: 255). Considered as a field research device, our project similarly works to find out what matters to engineering students, including allowing for the shared production and cross-validation of unexpected observations across divergent epistemic commitments. This is true, for instance, when deploying standard anthropological practices amongst the students, such as 'hanging out', come to afford new options for computationally oriented physicists to (re-)consider what they mean, in their own vernacular, by 'ground truth' (Madsen et al. 2018). It is equally true, however, when new practices of data visualization and pattern search across large-scale and granular digital datasets, as afforded in our CNS setting by the smartphone 'socio-meters', challenge standard ethnographic notions of what it entails to document a collective party ritual (Blok et al. 2017).

Rather than a weakness, we have thus come to consider a *plurality* of method tactics as inherent to what is productive about an experimental mode of inquiry, exactly because it allows one to test as-yet non-codified capacities of digital data and associated epistemic commitments. This is similar, then, to Marres' call for experimentation on the partly unknown capacities of digital infrastructures for social research. Yet, unlike Marres, it embraces rather than excludes more *specific* experimental tactics, including those allied to *some*, field-based versions of controlled-experimental ideals. Moreover, we by no means intend to practice or conceptualize this confluence in a romantic vein, glossing over the very real epistemic inequalities also at work (whereby, for instance, we are under no illusions as to the generally higher status accorded to our economist colleagues' work on the CNS data than to our own, CALL-based work on the same data). Rather, as detailed elsewhere (Madsen et al. 2018), we consider such to be part of what we describe as transversal collaboration, whereby the very encounter between otherwise rather incommensurate experimental registers may *itself* produce unexpected new possibilities, small and large.

Ultimately, this commentary hopes to engage in conversation with others from allied research experiences, where several experimental registers converge or diverge into productive confluences. Far from seeking to unify ideas and practices of social data experiments, however, it should be clear that my motivation for this commentary is rather the opposite. By exploring productive tensions and subtle differences in the sites, aims, and methodologies of experiment-informed social data inquiry, one would hope to initiate a process of collective learning on the *many* viable forms of experimentation co-inhabiting the current 'big social data' moment and their *singular* conditions of epistemological, ethical, political, and aesthetic efficacy. It is my contention that, in spite of all the invocations of experimentalism in recent digital and/or interventionist STS, we still collectively have much to learn about the important research possibilities ahead.

Such collective learning might also help to avoid tendencies manifest in recent socio-cultural theorizing––including, as I have argued, STS––that suggest experimentation can, at best, attain a metaphorical or analogical status. These conceptual tendencies problematically proceed as if the invoked form, the experiment, was *itself* an uncontested entity (cf. Guggenheim 2012). Rather, and conversely, a suitable starting point might be to adopt a certain 'experimental' frame of mind as to what constitutes an experiment and what one might become in the realm of social data science and beyond. This calls for, as noted, a certain meta-experimental inquiry which aims to test the limits and possibilities, the distinctions and variations, and the various family resemblances contained in invocations of experimentation as a privileged route along which to pursue the promise of adequate knowledge held out by large-scale digital social data. It also calls for, as I have hinted at, more concerted engagement with previously under-appreciated strands of social science methodology, Dewey being one key example to which I turn shortly.

## Reading digital STS back into pragmatist experimentalism

One arguable way of clearing some space for this is to deepen digital STS' embryonic attention to the precise ways in which STS scholars and historians of science complicate the meaning of experimentation in the *natural-physical* sciences. Ian Hacking (1983), as mentioned, provides one important account, in which he basically recasts standard assumptions about the function of experimentation. Hence, while experiments are often understood as devices for *testing theories*, from careful historical study, Hacking (ibid.: 229-30) arrives at the conclusion that experiments in physics and chemistry serve more importantly to "create, produce, refine and stabilize" new, previously unknown phenomena. Hacking, as is well known in STS, takes this view as consistent with realism about the entities in question: the artificial set-up of the experiment is needed to *isolate* objects of knowledge as discernible and regular events under definite circumstances; events that are noteworthy because the new object does *not* fit into current theoretical accounts. Here, while we may want to debate Hacking's version of realism (Latour 1990; 2003) and its so-called causal theory of reference (Resnik 1994)––whereby entities are 'real' only if they can be used to manipulate other entities––his list of experimental aims in physics and chemistry can still serve as inspiration.[3]

In related ways––although more attuned to the modern history of laboratory biology––historian of science Hans-Jörg Rheinberger (1994) coined the notion of the 'experimental system' in order to speak of the experiment as an intricately woven knowledge-generating machine. Such a machine, he suggests, combine technical, institutional, social and epistemic aspects in always site-and problem-specific ways. The experimental system, Rheinberger asserts, quivers with uncertainty, since the phenomenon under study––what he dubs 'the epistemic thing'––has not yet been stilled or domesticated by epistemological resolution. Such uncertainty as to the precise contours of the epistemic thing in question is what experimentalism feeds on. Indeed, a living experimental system, Rheinberger argues (1994: 77-8), always has "*more stories* to tell than the experimenter at a given moment is trying to tell with it". This argument certainly resonates with our own local research experiences in the CNS project. More generally, it serves to highlight the liveliness of experimental research practices, and hence the character of the experiment as what philosopher of science Isabelle Stengers (2000) calls 'an inventive event'.

In an interesting extension of Hacking's argument to the domain of laboratory-like experiments in economics, historian of science Mary S. Morgan (2005) concludes that the epistemic power of experiments,

[3] I thank an anonymous reviewer for prompting this important qualification

relative to mathematical models as a method in economics, lie in the former's ability to not just 'surprise' but to actually 'confound' the experimenter. Whereas unexpected model outcomes can always be traced back to and re-explained in terms of the model itself, a properly conducted experiment in which some degree of freedom on the part of participants is preserved, has the capacity to serve up patterns of behaviour unexplainable at that current moment. This, according to Morgan, is how Edward Chamberlain famously used his early classroom experiments in the late 1940s as a means of questioning assumptions about 'equilibrium prices', eventually replacing such market models with one of monopolistic competition. In this account, experimental manipulation and theoretical speculation thus goes hand in hand, as confounding observations in the experimental setting leads to a creative process of new theorizing.

This entire commentary is testament to the fact that there is every reason to think that the domain of digital social data, writ large, offers up many new possibilities for strengthening such an inventive experimental ethos and practice in various branches of the social sciences––as well as in wider collaborative settings, extending into contemporary art, digital activism, and beyond. In exploring such possibilities in actual research practice, however, and in trying to more precisely render the various experimental registers involved along meta-experimental lines, it might also be worth, I suggest, revisiting earlier and more fundamental debates about the possibly inherently 'experimental' character of the social sciences. In doing so, researchers in digital STS and beyond could explore whether and how experimental devices and styles of reasoning perhaps *always* warranted more prominent positions than standardly assumed, while also searching for important family resemblances among their otherwise divergent experimental registers.

I want to end this commentary with a focus on an argument by American pragmatist John Dewey, who, in the 1930s, suggested that the *logic* of social inquiry must be experimental by definition, even as its actual method practices might well be highly diverse (Dewey



1938). As we would expect from a pragmatist like Dewey, of course, this argument relied on a particular sense of the practice and value of experimentalism, one that, I would argue, holds great interest for engaging the present moment of social data. To reiterate, the point here would not be to inadvertently collapse important differences in the sites, devices, and practices making up specific social-science experimental registers. Rather, Dewey's vision of social inquiry might serve, I suggest, as an important (re-)staging of the wider meta-experimental promise of digital social research––one that avoids the pitfalls of the 'standard' social-science configuration (Guggenheim 2012) and thereby frees up new energy to search for alternative compatibilities.

Central to Dewey's thinking about social inquiry, which I can only sketch briefly here, is the fact that his approach was based on a *non-positivistic* account of the natural sciences as doing more than gath-ering pre-existing 'facts'. In natural as well as in social science, he argued, inquiry starts in a 'problematic situation', an experience of difficulty or trouble, which the inquirer turns into an obstacle to be overcome or a problem to be solved. The core of experimental logic, on this account, is that it allows for controlled and intelligent ways in which to relate research activities closely to their practical consequences. "What scientific inquirers *do*, as distinct from what they say", wrote Dewey (1938: 498), "is to execute certain operations of experimentation––which are operations of doing and making––that modify antecedently given existential conditions so that the results of the transformation are facts which are relevant and weighty in solution of a given problem". There is never any 'immediate' or context-free knowledge, then, but only inferences to be worked out in relation to a given problem, which has presented itself as being of relevance to both scientific research and its socio-technical context (or 'existential conditions').

In also suggesting the importance of such an experimental logic to the *social* sciences, Dewey (1927: 202) was quite explicit that what is at stake is exactly "a certain logic of method", a way of thinking, and "not, primarily, the carrying on of experimentation like that of laboratories"––although it should be noted that Dewey kept the latter as an option, as did Garfinkel and Cicourel at a later stage. In the case of social inquiry, he argued, the predominance of *non-recurring* temporal sequences as well as the close involvement of associated socio-cultural factors in the operations of inquiry, makes the controlled variation of sets of conditions difficult, if not impossible. Yet, anticipating the logic of the 'quasi-experiment', Dewey (1938: 509) nonetheless saw great potential for "careful, selective, continued observation" of the conditions and consequences that follow from the introduction of social policies or other developing courses of social events. Indeed, the need to institute new "techniques of analytic observation and comparison", such that "problematic social situations may be resolved into definitely formulated problems" (ibid.: 494), was what Dewey saw as the prime challenge of the social sciences of his time. It is hard, I think, in the present context to miss the way such a call foreshadows many of the promises invested in new digital social traces.

To Dewey the pragmatist, there could be no question of assimilating his experimental logic and the call for new instrumentalities of observation to prevailing notions of any simple 'empiricism'. "All competent and authentic inquiry", he wrote (ibid.: 497), "demands that out of the complex welter of existential and potentially observable and recordable material, certain material be selected and weighted as data". In other words, Dewey was well aware that 'raw data is an oxymoron', to use contemporary language (cf. Gitelman 2013). On the other hand, he was especially critical of those dominant 'rationalist' strands of social thinking that took their own theoretical ideas as absolutist truths and sweeping universals, whether one followed the liberalism of Adam Smith or the class struggles of Karl Marx. The prime lesson to learn from the natural sciences, Dewey argued (ibid.: 505), was to stop thinking of social concepts "as *truths* already established and therefore unquestionable", and to treat them instead as "*hypotheses* to be employed in observation and ordering of phenomena". On such a view, he asserted, one would positively welcome a plurality of hypotheses for any given problem, as the existence of explicitly formulated alternatives would



render inquiry more extensive, more flexible, and more cognizant of the need to revise received ideas (such as in the case of 'surveillance capitalism', as I have indicated, and its likely variations).

What is perhaps most interesting about Dewey's position, finally, is the far-reaching and perhaps counterintuitive implications he drew in relation to what Noortje Marres, whose ideas about digital sociology I sketched in the beginning, calls an interventionist approach to inquiry. Anticipating what certain STS scholars would later dub 'technical democracy' (Callon et al. 2009), Dewey suggested that, even in the case of the physical sciences, any *complete* test of their knowledge claims would eventually require taking into account the relevant consequences brought about by the material extension of such claims into the technically non-scientific public. Even more so for the social sciences, he argued (ibid.: 499), the "connection of social inquiry, as to social data and as to conceptual generalizations, with practice is intrinsic not external". In ways inherited later on by C. Wright Mills (1959), Dewey argued that social inquiry grows out of actual social tensions or 'troubles', and must orient itself to its 'existential resolution', as mediated by the way such 'troubles' manifest themselves amongst concerned democratic publics. Dewey-inspired digital social research now experimenting on new data-publics (e.g. Madsen & Munk 2019) would, I believe, stand to gain from closer articulation vis-à-vis this experimental logic of social inquiry.

While thus adopting an explicitly experimental logic, Dewey just as explicitly rejected standard notions of 'value-neutral' social science, aligning his view of social inquiry rather towards democratic theory and practice. The social sciences work, as it were, as the cognitive organs of a well-functioning democratic society, oriented to its continual and indeed experimental self-improvement (Dewey 1927; Haworth 1960). What this meant, however, was that the values and relations at stake in any given situation of social inquiry––including the plans and values adopted by the social scientist; what Dewey called an endin-view for problem resolution––was as much a part of the experimental process as anything else. In the end, the determination of social facts via an experimental logic was thus co-terminate, to Dewey, with an understanding of their relations and significance to plans for dealing practically with troublesome social phenomena. In such a vision, the experimentalism of social inquiry is a *recursive* one: at any given moment, the social scientist must take as her starting point a problematic social situation that is, to a greater or lesser extent, *itself* the product of previous rounds of interventions and experiments driven partly by social inquiry.

## Concluding remarks: redrawing STS' digital-experimental map?

To end here, and to briefly summarise, this image or vision of a recursive experimentalism of social inquiry––and the way it interlinks questions of data, instruments, theory, ethics, and public accountability in intrinsic and problem-specific rather than extrinsic ways––seems to me of great interest as one way of appreciating the current experimental moment of digital social data in STS and beyond. It is a meta-experimental vision of social science, writ large, one seen as equally committed to its possible value as an organ of credible knowledge and public intelligence as to a relentless and, indeed, 'experimental' questioning of its received conventions and ideas. Such received conventions, clearly, should include what are otherwise accepted tropes in STS discussions on digital methods (Madsen & Munk 2019), as well as ideas of what constitute 'properly' interventionist (digital) STS––ideas that, I have suggested, may be fruitfully questioned via closer and more precise attention to the tensions and compatibilities of several practical-experimental registers.

As such, and importantly for my commentary on Marres' (2017) otherwise highly inspiring and pertinent call for *Digital Sociology*, it is thus also a vision of the current social data moment that insists on the possibility of contingent cross-fertilization across otherwise distinct styles of reasoning, including those now crystallizing under the rubrics of computational social science and digital methods, respectively. Both, I believe, will have important, oftentimes distinct and disjunctive, yet occasionally mutually enriching, roles to play in forging new forms of digital social inquiry (see Veltri 2019). In years to come, I venture, scholars within and outside STS may well want to adopt a similar twin commitment: that is, to work simultaneously to appreciate *and* to critically test the plurality of ways in which data-experimental devices and practices can today be leveraged in the service of furthering the call of social knowledge.



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# Making space with data
## Data politics, statistics and urban governance in Denmark

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## Abstract

In this article we engage with the contemporary data moment by exploring how particular data practices–– consisting of census data and statistics––have become embroiled in the making of urban space and governance in Denmark. By focusing on the controversial case of Danish "ghettos"––a state-sanctioned list of marginalised urban areas––we show how Danish data practices of routinely collecting and aggregating extensive census data have become central to ascribing particular urban neighbourhoods as ghetto areas. These data practices spatialise residential housing areas as problematic and influence Danish urban governance. We explore how new forms of data practices for monitoring urban areas arise, and argue that these practices help to maintain the spatialisation of the "ghetto list". They do so by drawing multiple forms of data together, that visualise and monitor "at risk" areas making them governable and amenable to physical changes. Finally, we show how the state uses data practices to make citizens (and municipalities) accountable; yet, this accountability cuts both ways, as citizens and municipalities also use data to hold the state accountable. We end with a discussion of how our analysis of data practices has implications for how we imagine the scalar hierarchy of the state and the politics of data.

**Keywords**: urban governance, data politics, state, space, spatialization

## Introduction

How should we think about data and the state? In this article we explore how data are used in urban governance in Denmark, focusing on the connection between census data (such as the well-known Danish CPR registers) and the state's ability to make space, that is, to classify or transform particular spaces. Recent studies on the role of data practices in government have argued that these practices perform a crucial role in constituting the people inhabiting various areas as "knowable" and "governable" entities (Cakici et al., 2020). Increasingly advanced metrics and visualisations are considered an important way of making certain areas and connections problematic, commensurable, and thus governable (Espeland and Stevens, 1998; Mennicken and Espeland, 2019). Indeed, citizen data––in terms of government registers containing, for instance, population numbers, economic information (for taxation purposes), or demographic data––have historically been crucial for political and economic attempts at governing subjects. Hacking (1991) has described the period of the early 19th century when numbers and statistics became an increasingly important mode of state governance as an "avalanche of printed numbers." Census data and statistics were gradually absorbed into the bureaucratic machinery conforming to an apparent governance ideal of "information and control" (Hacking, 1982: 280). Nowadays, such citizen or census data are digitised and stored in ways that make them accessible and combinable in new forms. These kinds of data are part of the "techne of government" (Flyverbom et al., 2017), because they enable formal schemes to see with (Scott, 1998) and various visualisations of that which is to be governed (Dean, 2010: 41)[1]

If we want to understand contemporary state governance, we must also understand the data practices on which it builds, that is, practices of data registration, statistics and calculations, along with their politics (Cakici et al., 2020). Drawing on three empirical examples of the Danish state's governance of so-called "ghettos," we explore the crucial role played by data practices in problematising and making certain areas knowable and governable. Theoretically, we draw upon Ferguson and Gupta's (2002) work on the notions of verticality and encompassment in relation to the spatialisation of states. Following this, we argue that Danish data practices are a key part of creating an image of a state that encompasses and sits above its citizens, and that these images are key

[1] The Danish government considers basic data (what is also termed "grunddata") on, e.g., citizens and housing to be crucial for public administration; it argues that these kinds of data are the digital raw material of Denmark (see also www.grunddata.dk).

to governmental authority.

First briefly discuss the history of statistical data after which we describe the theoretical framework for the article. We then proceed to analyse our three examples: the making of the Danish "ghetto list," the creation of local monitoring of marginalised urban areas in Denmark, and lastly the contestation of the data which these practices build upon.

## Data, statistics, and classification

How did statistics come to be? As Alain Desrosières (Desrosières, 1991, 1998) has argued, the word "statistics" originated in Germany sometime in the 18th century, and referred to a "science of the state" (Desrosières, 1998: 179; see also Louckx and Vanderstraeten, 2014). It was, intriguingly, not a framework of numbers, nor the system of calculation we know today. Instead it was a framework for ordering (Desrosières, 1998: 326), producing taxonomies, and organising facts (Desrosières, 1991: 200, 1998: 19–20). It was only in the 19th century that the numerical description of the state emerged and, according to Desrosières, it was not until the 20th century that statistics became a series of mathematical techniques that could be applied to any type of data (Desrosières, 1991: 200). In other words, statistics have deep historical roots not just in the "science" of the state, but also in the classificatory and taxonomic practices and criteria that are integral to the constitution of the state itself. More generally, Law (2009b) has argued that statistics are practices that can perform countable populations and other collectives. Thus, collectives can be performed in different ways, depending on the concrete application of statistical methods and, in our vocabulary, depending on specific data practices.

This brief history of statistics may seem esoteric in the light of our "contemporary moment" of big data and advanced algorithms, where new data practices are being promoted. The term big data was promulgated by industry as a way of departing from orthodox uses of data statistics, and it has been leveraged by governments and corporations for various purposes (Laney, 2001; Ruppert et al., 2017; Zikopoulos



and Eaton, 2011). Scholars writing about big data sometimes note that the term bears a (historical) resemblance to the big data sets produced by academics and state governments, such as the national census, or the historical relationship between statistics, numbers, and the advent of the modern state. For example, Beer (2016: 2), stresses that our contemporary big data moment does not represent a historical break but rather a continuity with the classificatory practices of the 19th and 20th century. In contrast, Kitchin (2014) argues that the contemporary moment of big data seems to be characterised by a degree of precision, flexibility, volume, velocity, and variety that "older" forms of big data––such as the national census––did not. To remedy these two perspetives we argue, along with Mazotti (2017), that while census data practices might not typically be seen as part of the contemporary moment of big data, advances in computer power, digital visualisation, and data analytics in recent decades influence the use of census data and how governance abilities are imagined (Mazzotti, 2017). Today, census data are digitised, and the practices leveraging these kinds of data are entwined with new analytical modes, which require digital and statistical literacy (see e.g. Danish Transport, Construction and Housing Authority, 2019a). Hence, the use of census data, we argue, cannot easily be, and should not be, separated out from the current data moment. In fact, census data and the ability to make a population countable remains central to contemporary urban governance and the constitution of the state (see also Cakici et al., 2020). Studying the role of census data in current data practices provides important insights into the politics of data, and how data compose problems and is generative of new relations of power at different scales (Ruppert et al., 2017: 2).

## Making space: Verticality, encompassment and data politics

In this section, we turn to Ferguson and Gupta's work on the spatialisation of states (2002). Building on prior studies of the social construction of space, for instance studies in social geography of how urban space is shaped and experienced (Massey, 1994), Ferguson and Gupta (2002) question not only how the state constructs social and economic space but also how the "state itself is spatialised" (Ferguson and Gupta, 2002: 997). In doing so, they treat the state not as a spatial container, but as "bundles of practices" which are themselves a form of social organisation that compete with other social organisations in the spatialisation of certain areas. They are particularly interested in deconstructing the common image of the state as something stable, an entity that spatially encompasses territory and sits somehow above other smaller entities (such as communities) (Ferguson and Gupta, 2002: 981). They argue that there are two central images in both popular and academic ideas about the state's spatial properties, namely "verticality" and "encompassment" (Ferguson and Gupta, 2002: 983). Verticality, they posit, is the idea of "[…] the state as an institution somehow 'above' civil society, community, and family" (Ferguson and Gupta, 2002: 983). They argue that the state, cast in this image, becomes an entity exercising its power "top-down" rather than "bottom-up", or in other, more "organic", ways (Ferguson and Gupta, 2002: 983). The concept of encompassment, meanwhile generates an image of the state as a location within which other locations are nested. Here, localities are encompassed by larger entities such as regions, which are again encompassed by even larger entities such as states (Ferguson and Gupta, 2002: 983). Ferguson and Gupta (2002: 983) argue that these metaphors combine to perform an image of the big state which encompasses a series of 'smaller' entities within it––citizens, regions, cities, communities, and so on––in a hierarchical order. Their point is that this idea of vertical encompassment, which elicits the state an entity sitting above a series of other entities (communities, for example) is just that, an idea, a way of talking about and seeing the world rather than a strict representation of an empirical reality (Golub, 2006). As we shall demonstrate in what follows, vertical encompassment is an image as much as a concrete reality, albeit an image that becomes central to the state's making of space. At the same time, it is an image that is not



restriced to the idea of the state alone, but also to other geographical qualities of areas, such as social problems.

Routine bureaucratic practices such as data registration are one means by which vertical state encompassment is performed (Ferguson and Gupta, 2002: 984). To illustrate this point briefly, let us consider the example of the Danish Centralised Person Register (which is abbreviated in Danish as CPR). In Denmark, all citizens are assigned a CPR number at birth, a unique signifying number which is used as a sort of entry point to services in Danish society. Thus, visits to the doctor will require one. The patient uses the number to prove their identity, and the doctor uses it to gain access to the citizen's information: their address, age, gender, and so on. Further, Denmark (as with the other Nordic countries) has collected extensive data on its citizens since at least the 19th century, registering births, deaths, disease, social conditions, income, ethnicity, and so on (Thygesen et al., 2011). Coupled with the use of CPR numbers, these registers allow researchers (for example epidemiologists) and the state to draw together very detailed data, and even to link different registers (Pedersen, 2011; Thygesen et al., 2011). The data produced by these registers is, we would argue, a form of census data. This bureaucratic practice produces images of both verticality and encompassment via data. It produces an image of encompassment insofar as this provides the Danish state––as well as regions and local municipalities––with continuous demographic information about their citizens: who lives where, where they move to, how many people are employed, what their income is, and so on. Thus, from these bureaucratic data practices, the Danish state, its regions (Denmark is divided into five geographical regions) and municipalities encompass each other and specific citizens. Municipality X encompasses citizens registered within it, and this municipality is in turn encompassed by region Z, which encompasses other municipalities and other citizens, and so forth. This further produces an image of a scalar hierarchy: the municipality is "above" the citizen, the region is "above" the municipality, and at the top sits the state apparatus, tracking and charting overall developments. We do not mean to suggest that the state encompasses practically all aspects of its citizens' lives through the CPR system, but that the CPR system is part of how images of encompassment and verticality are performed, and this has implications for how governance becomes ordered. Crucially, these images of the state have effects, as they are part of what legitimates state authority and power.

Following this, governing space through data becomes a matter of sorting out which data are significant or insignificant. This means that governing through data (like all governance) is vested with different interests and is a political matter (Dean, 2010; Aradau and Blanke, 2017). Indeed, as Ruppert et al. (2017: 2) argue, data are entangled with power and politics, both in terms of their collection (who does the counting? what is counted? how is it counted?) and how they are put to use and made to matter. As we shall see in the following sections, power and politics in Denmark clearly play out in the case of ghettos and marginalised urban areas. Instead of considering census data as representing which citizens live where, we follow the performative perspective of STS (e.g. Law, 2009a, 2009b), by claiming that census data perform types of citizens, types of areas, and their various problems. Rather than assuming that these data show the world as it really is, the usage of data to picture the world involves choices that perform certain ideas about space, as we will now go on to explore.

## A note on methodology

In light of the above, the approach we are taking in this article is to analyse how these data practices perform images of verticality and encompassment. Empirically, our analysis is based on documents and newspaper articles collected by the first author during his PhD thesis; a multi-sited field study of social work in marginalised housing areas in Denmark undertaken between 2014 and 2017 (Birk, 2017b). The documents and articles pertain to the governance of these areas, and



include, for example, the yearly instantiations of the ghetto[2] list and the laws that regulate them. We supplement this material with more recent documents, such as newspaper articles that have explored controversies over the quality of the data used in the governance of these areas. The analysis is also partly based on a series of documents published between 2018 and 2019 by the Danish government that concern the most recent instantiation of the ghetto list. All quotations from policies and similar documents have been translated into English by the authors.

In analysing these documents, we looked for examples of how census data were used for spatialising certain areas and making them knowable and governable. Inspired by the tradition within STS of considering controversies and breakdowns as revealing situations (Latour, 2005), we examined the role of data practices in spatialising certain areas. We present three examples, each of which demonstrates how data practices were constitutive in spatialising residential areas as "ghettos". In our first example, we show how census data are leveraged for making the ghetto list. Our second example illustrates how data practices become crucial in continuing this line of governance as tools for monitoring and governing urban areas at a municipal level. Finally, we show how data practices are contested and how their partiality and politics are revealed.

## Example 1: The ghetto list – making and problematising space with data

Our first case is the making of the Danish "ghetto" list. Every year, since 2010, the Danish state has developed and published a list of non-profit housing areas that they classify as "ghettos".

The "ghetto list", as it is called, is thus a list of different geographical

[2] We are aware of the many controversies surrounding the very word "ghetto". In this article, we use the term primarily because this word has become an institutionalized element of Danish politics.

areas in Denmark that qualify as ghettos based on a number of metrics. It works as a tool for regulating and surveilling these supposedly problematic areas, and hence it acts as a spatialising authority. Internationally there is a good deal of sociological discussion on what ghettos actually are (see e.g. Wacquant, 1997, 2016). But in Denmark, the "ghetto"––as the sociologist Schultz Larsen has argued––is a bureaucratic reality upheld by comprehensive and detailed statistics (Schultz Larsen, 2011). The list is the result of years of polarised debates over immigration and moral panic about not-for-profit housing areas supposedly being ghettos, predominantly inhabited by refugees and immigrants (see also Diken, 1998). In 2010, the Danish parliament legislated that the ministry responsible for housing must draw up an annual list of the number of ghettos in the country.

The Danish ghetto legislation has a series of specific criteria that define which areas qualify for this label. First and foremost, this legislation specifies that only areas of public, not-for-profit housing ("alment boligbyggeri") can be considered a ghetto (Ny ghettoliste - Transportministeriet, 2018). Thus, areas of predominantly private housing cannot be labelled ghettos under this law. The remaining criteria, as we show below, pertain to statistics about the amount of residents who have criminal records, or who are for example unemployed.

In 2018, the Danish parliament approved a new instantiation of the law, which distinguishes between the "toughest" ghettos ("hårdt ghettområde"), the ghettos ("ghettområde"), and marginalised housing areas ("udsat boligområde"). A not-for-profit housing area now qualifies as marginalised if it fulfils at least two of the following four criteria, based on two-year averages:

1) More than 40% of residents (age 18-64) are outside the labour market and not in education.
2) More than 3 times the national average of residents have been sentenced for violating Danish crime, weapon or drug laws.
3) More than 60% of residents (age 30-59) have had no education other than obligatory Danish schooling.
4) Excluding unemployed residents, the average income of residents (age 15-64) is less than 55% of the regional average.

For an area to qualify as a ghetto, it needs to fulfil two of the above criteria (thus classifying it as marginalised) and have more than 50% of its residents classifiable as immigrants or descendants of immigrants from "non-Western countries." "Western" here, is a category that only includes people from the USA and Canada, Europe, New Zealand, Australia, and Japan. For an area to be classified as a "tough" ghetto, it must now have featured on the ghetto list for four years in a row. This legislation and, especially, the notion of ghettos, has received a considerable amount of critical attention in Denmark, some from academics, but mainly from local residents and politicians who frequently object to the stigma of having their local area named in such a way. Multiple critiques (e.g. Fallov, 2010; Schultz Larsen, 2011; Wacquant, 2016) have shown that the list makes social problems (such as unemployment) a problem of ethnic minorities. In this sense, it builds upon a nativist and xenophobic element of Danish political discourse, something which is made exceedingly clear by the criterion of being non-Western.

In addition to these critiques, Birk (2017a) has argued that the list provides a common metric that enables comparison between different geographical areas by way of numerical properties, hence making them commensurable and comparable. The list makes the ghetto a decontextualised space; the differences between the local areas disappear, as do their individual histories, their populations, their local politics. Additionally, we stress that statistics and data registers are crucial data practices for making "ghetto spaces" and carving out the geographical boundaries of these areas. This is because numerical criteria (e.g., of unemployment, or criminal records) are only established through data practices. Different ways of measuring or defining criminal records for example, would result in a different count (note that it is not the amount of crime in the areas that is measured, but rather the amount of people who have criminal records––this says nothing, therefore about the actual "criminality" of any given area at a current moment).

The ghetto list itself is an example of how images of encompassment become produced, stabilised, and circulated. This happens via the list's utilisation of registry data which link the lives of citizens, social problems, and marginalised areas. These are then disseminated widely in the press each year when the list is published. This image of encompassment is simultaneously deeply normative; its ranking is based on ostensibly objective data, yet it is used politically so as to focus on particular characteristics (such as one's national background as Western or non-Western).

Furthermore, the ghetto list performs an image of these areas as fully encompassing problematic modes of living, which contrasts of course with the actual and practical lives of those who live in them. People, obviously, rarely spend all of their time in just one place, but the list performs an idea of these problems as encompassed within the ghetto, rather than seeing it in a wider and societal context. This lack of contextualisation comes back to the data the list is based upon. As a data point, the CPR number links people to certain addresses. It does not track where they work, where they go, or how much time they spend in different places; hence, it produces a static idea of what an area is. These data thus produce momentary snapshots of people's lives within very specific parameters. This also has a temporal dimension to it. The list is always based on statistics that, at the time of publication, refer to the previous year. For example, the list that came out in December 2018 was based on data from 2017––thus introducing a temporal lag between the statistics and the classification of the area (Danish Transport, Construction and Housing Authority, 2019b). Similarly, as Schultz Larsen (2018) has argued, these data focus on people (e.g., their employment status) rather than the wider structural context such as the availability of jobs.

Summing up this example, the ghetto list is based on the ongoing automated practice of citizen data registration where data about ethnicity, place of birth, employment, income and residence is registered. Combining these registrations with politically produced criteria for what constitute a problematic area results in the composition of certain



areas as spaces with problems in need of political interventions (see also Dikeç, 2007).

## Example 2: Using data for top-down interventions

In this section we move closer to some of the practical initiatives that result from the ghetto list. Our central point here is that while the ghetto list, at a basic level, produces an image of encompassment; the local, small-scale monitoring initiatives that result from it produce images of both encompassment and verticality. As we shall see, these initiatives perform images of hierarchy and power and of those who have the right to monitor and intervene. The vertical image is entwined with an image of the kinds of areas that are contained within local municipalities.

*T*he ghetto list poses a problem for Danish municipalities that have a vested interest in not having their housing areas classified as ghettos. Thus, various local initiatives attempt to intervene in these areas, often via the use of different forms of social work (Birk, 2017a, 2018; Fallov and Larsen, 2017). However, because the list is only produced annually, many municipalities and local housing associations have explored more frequent ways of monitoring which of their areas are not just on the list, but "at risk" of being on it. Thus, the Danish National Association of Municipalities ("Kommunernes Landsforening") have over the last five years or so started to promote a monitoring system for marginalised housing areas. This system is called "boligsocial monitorering," a term that roughly translates to "Social Housing Monitoring;" it has been described by the association as a "tool" meant to aid "strategic work" with marginalised areas and to "monitor" the development in these areas (Kommunernes Landsforening, 2015: 3).

The purpose of this tool is to draw together even more census data than the ghetto list and to link them with geographic locations, to monitor continuously areas on the ghetto list and areas considered marginalised or otherwise defined as being at risk.

This tool is intended to use the detailed census data that the Danish municipalities have access to, for example, citizen data (based on

CPR data), employee data, educational data (including data from primary schools, pre-schools, and nurseries), data on disabled and elderly citizens, data on children at risk, and data on municipal finances (Kommunernes Landsforening, n.d.). By combining these with the coding of geographic locations, frequent statistical overviews of marginalised housing areas can be created. The National Association of Municipalities, in their initial report on this topic, noted that more frequent data on marginalised areas can enhance ongoing interventions, improve decisions made by politicians, or monitor political strategies (Kommunernes Landsforening, 2015). At a basic level, as the ghetto list is only published once a year, the tool is described by some municipalities as being able to “ensure more frequent and more updated knowledge compared to the government’s annual ghetto list” (Kolding Kommune, 2019b, not paginated).

One municipality describes the purpose of using this form of data-driven monitoring as follows:

> Social Housing Monitoring can thus serve as the basis for a data-based knowledge about Kolding Municipality’s residential areas. It can thus be used actively in strategic work with marginalised residential areas. At the same time, up-to-date knowledge about the residents in the different areas can be used to focus specific interventions. (Kolding Kommune, 2019a, not paginated)

What this quotation shows is that monitoring is firstly a continuous performance of an image of encompassment, because the residential areas are named as belonging to this particular municipality. Secondly, and crucially, it also performs verticality, in the sense that this municipality is established as an authority that can use the data for top-down interventions (Ferguson and Gupta, 2002). Monitoring citizens thus becomes a way to construct images of the vertical encompassment of the local.

In these initial considerations of “boligsocial monitorering,” we see not just a concern about what types of areas are encompassed in a given municipality, but also about how data are used to establish strategies



and practices for interventions. Here, vertical encompassment is both the entanglement of hierarchisation (i.e., who governs whom, and how) and the ascription of (so-called) social problems to particular geographical locations.

This is also evident in one of the key properties of the monitoring system, namely its ability to visualise vulnerable residential areas, as the following figure exemplifies (from Jørgensen, n.d.):


The yellow colour represents areas at risk; the orange represents areas with difficulties and needs; and the red represents areas with specific challenges and needs. In a very obvious manner, this bird’s eye view performs an image of vertical encompassment exactly by producing a view from above. The view is not neutral; rather, it performs a hierarchy. Note the many different areas; the image is not meant for the people living in any of the places it shows, nor even for the social workers on the ground. Instead, it is quite literally a top-down view, designed for purposes of comparison and contrast. These data points are in the hands of officials “higher up” the bureaucracy who get access to an overarching vision of the local, to aid in their governance (Ferguson and Gupta, 2002: 988).

This mode of mapping and visualising via colour codes provides a spatialising image that legitimises the authority of the municipality to intervene in those areas, and it evokes an image of vertical encompassment. It not only reasserts which local areas are encompassed within the city of Aarhus; it also produces a view from above of which areas are at risk, and where certain interventions may be needed. Its verticality implies power and hierarchy, and signifies who gets to compare, monitor, and intervene.  In this way the tool, via visualisations, becomes a representation of the prioritisation of resources and interventions in certain areas. Paraphrasing Latour (1986), Dean (2010: 41) notes that such visualisations allow politicians and governance practitioners to "think with eyes and hands." Their data practice becomes a way of performing an image of vertical encompassment, whereby certain areas are demarcated, problematised, and contained within the municipality. They further assert their authority by deciding on the need for certain actions. In sum, the authorities have a tool to monitor, compare, strategise, and intervene. Interestingly, these official documents are vague when it comes to this last point. The idea of intervention saturates the documents, but still remains vague. For example, the National Association for Municipalities suggests that Social Housing Monitoring can be used to "prevent" new areas on the ghettolist, or to "initiate" new projects (Nyt projekt om boligsocial monitorering, 2020).

Social Housing Monitoring is a direct continuation of Denmark's "ghetto politics" and is preoccupied with accounting for lives in marginalised areas that are perceived to be, a priori, problematic. But at the same time, this monitoring has a paradoxical relationship with the ghetto list; while the purpose of the monitoring tool seems to be, at least implicitly, to avoid having more areas classified as ghettos, the system has been created because of the ghetto list and employs the same logic and many of the same types of data (but at different scales and temporalities). At the same time, it is also a type of protest, as it is part of an attempt to avoid (and even escape) the stigma of the list.

To put it another way, the municipalities try to represent what is happening (e.g., in terms of education, occupation, crime, and so on)



in a certain area and how it is impacting life within this area. This illustrates a "jumping" in "scales" (Ferguson and Gupta, 2002: 996) ), where the state is not the only authority. Instead, the local municipalities perform an image of vertical encompassment of the different areas through advancing data practices which integrate visualisations with traditional census data.

## Example 3: Contesting space with data

As we have seen, detailed CPR data––which we consider a form of census data––have spatialising properties and are crucial to the making of the ghetto list and the continuing practices whereby municipalities monitor and intervene in marginalised areas. As many interventions aim to make local residents and communities responsible for their areas (Birk, 2018), these data points contribute to making citizens accountable for the areas they live in. Yet the state and municipal claims to defining these areas can be contested (Ferguson and Gupta, 2002: 988). In the case we describe here, such authority was contested via data––about the educational backgrounds of local residents––which was not part of Danish registers.

In 2017, Fagbladet Boligen, a Danish housing magazine, published an article about the ghetto list. It focused on the educational level of residents in the areas that were featured (Nielsen, 2017). The educational criteria for inclusion on the ghetto list is based on the percentage of residents (at the time, more than 50%) that do not have further education beyond the state's obligatory schooling––or its equivalent. However, exactly because many immigrants live in these areas––by definition people who have not been part of Danish data registration practices for large parts of their lives––their educations had not been registered. There were, at the time, 177,000 immigrants whose education had not been registered (e.g., because they had completed their degrees in other countries), and so their educational achievements had not been recorded in Denmark's data registers. Statistics Denmark––the central, national statistics authority, and the agency providing the data for most of these calculations––had attempted to track the educational achievements of this group. They collected data from 65,000 people and used them to estimate the education level of the entire group. With the updated figures, the educational level in areas on the ghetto list were significantly higher. This is the crucial aspect of this example: if the list had been updated to reflect this new data (under the criteria of the ghetto list at the time), then the number of areas on the ghetto list would have been halved (Nielsen, 2017).

This new data was politically contested, as several municipalities saw an opportunity to have their areas struck from the list (see for example Nielsen and Hansen, 2017; Overgaard, 2018; Højstrøm, 2018). However, in response, the minister of housing acknowledged the updated data, but stated that using them would "mean a significant reduction in the number of ghettos and because reality has not changed, this would give the wrong impression of development in these areas" (Nielsen and Hansen, 2017, our emphasis, not paginated). The data practices suddenly translated into a controversy about the "realities" of the areas. The minister argued that:

> "[…] we can't just use data uncritically. 63% of the updated data are based on an estimate on the basis of information that are primarily based on self-reporting and are without documentation and less useful for data sets such as the ghetto list" (Sørensen, 2018, not paginated).

This quotation shows that, at first, the minister attempted to question the validity of this new data. But he soon seemed to abandon this strategy in favour of simply bypassing the data. In the ghetto list published later in 2017, a footnote remarked that the law meant that the new data could not be used, and that the ministry would resolve this issue in the list due to be published in December 2018 (Ghettolisten 2017 - Transportministeriet, 2017; Transport,- Bygnings- og Boligministeriet, 2017). This was a rather dubious explanation, as the law at the time did not say anything about what type of data could be used. Indeed,



rather than directly challenging the validity of the new education data, the ministry simply changed the criteria for the 2018 list. They were altered so that only education undertaken or otherwise validated in Denmark would count (Danish Transport, Construction and Housing Authority, 2019a). To make up for this tightening, the 50% criteria was adjusted upwards to 60%. This meant that despite fewer educations being recognized, an area now needed more people without education other than obligatory schooling than before, to qualify for the list.

This political contestation raises concerns about the representations of data (i.e., are they accurate enough? Do they accurately reflect the so-called reality of these marginalised areas?). Crucially, the dispute also revealed the relations of accountability that data practices open up. Because the ghetto list is ostensibly meant to be an "objective" tool reflecting reality––as the earlier quotation indicates––it also becomes open to contestation via the very numbers that lent it a veneer of neutrality.

Thus, this controversy can be read as an attempt by the local municipalities and housing associations to use new data to hold the state accountable for the veracity of its lists. In response, the government closed off the controversy by simply adjusting the data practice and tightening the criteria for what types of data would count. It thus became clear that what would not count were people's self-reports of education. The politics inherent in the earlier data practices, which had favorized educations of Western societies, are here formalized in the new metrics. In this manner, the government cemented its position as a spatializing authority: the final arbiter of which data would be allowed to count and which would not in the judgement of what constitutes a ghetto area.

In one sense, the government's explicit rejection of particular data could be interpreted as a move away from data-based politics. However, it is this very rejection that renders such data political, as it makes visible very particular political relations between data and accountability. On the one hand, the government's invocation of a particular law was a technique to delegitimize these new data and evade accountability.

But they were held accountable, nonetheless, even if only partially so. This partiality resided in the fact that they ended up changing the criteria of the ghetto-list, allowing them to close the controversy with relative ease. While this is a slightly complex example, the point is more simple: While data do indeed signal a numerical objectivity and neutrality, they are mobilized for accomplishing certain (political) ends as well. In other words: one may be accountable to data, but such accountability is not given, nor necessary.

## Discussion

In the preceding analysis, we have sought to illustrate how census data in conjunction with statistics do not simply account for certain urban areas but partake in making them. This argument has a twofold outcome. Firstly, our analysis contributes to an understanding of how data practices are entwined with the state––who relies on them to make top-down interventions––and secondly, it contributes to an understanding of data politics.

We have seen how both the state and municipalities become an authority, as they define, categorise, and intervene in urban areas (and social problems within them). This scalar operation performs the state as composed of, and concerned with, the lives of residents in certain areas. It also involves the state as, to paraphrase Ferguson and Gupta (2002), "acting from above" concerned with "larger issues." As such, the state performs an image of vertical encompassment––it sits at "the top" whilst simultaneously encompassing all its bureaucratic entities (regions, municipalities) and citizens (Ferguson & Gupta, 2002: 985). The ongoing performance of this image participates in the legitimisation of the state and the establishment of its authority. From this image of vertical encompassment, the state acts as a spatialising authority, which performs spaces in certain ways with certain needs (Ferguson and Gupta, 2002). As our case shows, data practices are a critical part in performing this image of vertical spatiality; they are what is used and relied upon when making decisions about interventions. Census



data and statistics become part of (political) data practices that reshape urban space, while simultaneously partaking in assembling the state as an encompassing and accountable actor, acting from above. This argument resonates with, but at the same time moves on from, Ferguson and Gupta (2002, p. 995) who suggest that "states themselves produce spatial and scalar hierarchies", and that these hierarchies are central to the functioning of government on both a local and national scale.

This leads us to a second point that represents an advance from current studies of the politics of data  (Aradau and Blanke, 2017; Flyverbom et al., 2017; Ruppert et al., 2017). The state's spatializing authority through data is challenged in example 3, wherein the state settles a matter of dispute by critiquing the ability of the newly available data to describe reality accurately. It later changes its methods of calculation so as to escape their likely ramifications. This is illustrative of how data practices generate new power and accountability relations . The state holds both the local municipalities and the local housing organisations responsible for intervening (locally) in areas classified as ghettos and the municipalities respond to this through local monitoring. While the data underlying the ghetto list come from Statistics Denmark––whose data are to a large extent publicly available for critical scrutiny and contestation by researchers, journalists, and community organisations alike––we see in example 3 that the data behind "boligsocial monitorering" is more opaque. The various municipalities are able to implement their own monitoring systems, drawing together different forms of data and carrying out different kinds of calculations, which may draw on internal and less publicly accessible data and, therefore, conceal certain interests. What our examples crucially illustrate is that the ghetto list and local governance outcomes are a result of the contingent data practices deployed. This is particularly evident in example 3. Data practices mark boundaries between those who are included and excluded by a certain calculation, and those who are allowed to intervene (see also Callon, 2010). These boundaries, and their associated interests, are justified on the grounds of numerical objectivity, but in example 3 a controversy emerges over the "normative neutrality" of data practices (Hacking, 1991), as the reliability of data are challenged from two sides.

## Concluding remarks

We began this article with a question about the relationship between the state and data. What we have shown is that, in the present cases, data and the state (specifically, urban governance in Denmark) are deeply entangled. The data practices we have described are a crucial part of how the state, regions, and even local municipalities construct themselves as authorities over marginalised areas. The modes of counting and calculating that the preponderance of census data allow are, in other words, not just a process of accounting for the population and the places they inhabit, but of making up the population and the places they live. The use of census data by government to produce the ghetto list and by municipalities to monitor these areas performs an image of state, or municipal, vertical encompassment. The availability of such detailed and digitised census data enable particular areas to be defined and categorised as ghettos, and intervened in on that basis. We have argued, therefore, that these data practices are central to the constitution of urban space.

The ghetto list, however, focuses on individual data and suspends the larger structural context in which any housing estate is inevitably embedded. When the state and municipalities use and rely on census data to make top-down interventions, the data are revealed not as neutral descriptions but as enablers and legitimisers of certain kinds of government action. The state and the municipalities constitute themselves as responsible agents who intervene and solve 'problems' in a manner that makes them, and the residents of these areas, accountable to each other. Yet, as became clear in example 3, data practices are not neutral; they can expose the political interests that order certain areas in certain ways. Following Latour (2005: 186), we suggest that the politicians and the practitioners leveraging the data are scaling-up and scaling-down specific problems through their use, simultaneously producing images of verticality and encompassment, moments of contestation, as well as constructing relations of accountability. It is important to mention that these data practices do not have the agency to conjure worlds into being by themselves, but they become a mediating interface between lives in the non-profit housing areas and the state, through which these areas are contained and governed by the state.

In sum, we argue that studying the role of statistics and census data in contemporary governance provides important insights into how data practices are imbued with questions of politics, oppression, exclusion and inclusion. To return to the present case, recent policies mean that areas which have been on the ghetto list for several years in a row must be converted from non-profit housing to private housing (which can only be achieved by selling properties). This means that people who have been living in these areas for decades, who have built their lives and livelihoods there(see e.g. Johansen & Jensen, 2017), are now being moved to other areas. Such governance is highly consequential for people's everyday lives and it results, in part, from the ability of data practices to invoke images of a vertically encompassing state, which can see from above. The data practices that underlie this governance may not, on the face of it, seem as consequential to our contemporary data moment as, for example, new developments in facial recognition algorithms. Yet, these data practices have certain commonalities given that both are oriented towards the transformation of actions into data points, producing governable urban zones and subjects. Moreover, as we argued earlier, exactly because the data practices explored in this article are largely enabled and developed in the context of the current data moment and indeed are consequential for people's lives, there is a need to continue to engage with such practices and their results.

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# Data on the move

## How household energy data travel and empower

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## Abstract

Even though Science and Technology Studies has highlighted how things and publics participate in energy assemblages, the specific role of big data has received relatively little attention. This paper examines the politics of energy data in relation to residential grid management. Informed by the concept 'data journey', developed by Bates et al. (2016), it proposes an 'energy data journey' approach and focusses on two questions: how are big data of smart homes produced and how do they travel? And who is empowered by this energy data production and movement? The paper addresses these questions in the empirical context of a Dutch-Belgian pilot project that has designed and tested energy management of a smart home. The empirical analysis shows how energy data and household profiles are created and travel through different cyber-physical locations to serve different purposes. The use of specific 'home energy profiles' is crucial and contributes to neoliberal energy management as it focusses on self-monitoring tools and users' responsibility, while empowering commercial tech-companies and high income groups. The final section reflects on the cyber-materiality of energy data and the techno-politics of energy data more broadly. The paper argues that an energy data journey approach is productive for STS researchers when critically reflecting on the agency and politics of energy data.

**Keywords**: data journey, energy, smart homes, techno-politics, empowerment

## Introduction

In recent years, automated home devices have captured the public imagination. Ranging from advertisements for convenient smart products, to dystopic futures in popular series such as Black Mirror, the home is clearly digitizing. Significantly, smart homes have also triggered the interest of energy grid operators, but in the form of grid innovation. Traditionally, homes without smart technologies ('dumb homes') only entered the radar of grid operators during brown-outs or electricity disturbances. However, as households consume increasing amounts of electricity, and deliver local renewable energy 'back to the grid' (cf. Darby, 2010), grid managers are trying to grapple with bi-directional energy flows and local energy peaks.

Digital energy technologies such as smart meters and energy feedback devices have already allowed households and grid operators to gain relatively detailed information about household energy flows (Strengers, 2013). After the liberalization of the electricity sector in many European countries in the 1990s, commercial energy companies and technology suppliers started playing a key role in the energy system. Grid operators increasingly cooperated with new (often commercial) actors to explore tools to govern electricity grids, including smart meters and smart grids. Another fruit of this development is the smart home. Importantly, not all smart homes are designed to manage or even reduce energy flows (some even lead to greater energy consumption). Specific smart homes that digitally monitor and manage energy flows are considered a promising innovation for grid management. Digital energy data play a key role in smart homes, especially in relation to the management of residential grids.

### Energy data and their politics

Data related to smart homes are not self-evident, fact-like entities, with naturally defined boundaries and functions. In the field of Science and Technology Studies (STS), much work has been done to unpack the relational and political character of technologies, including how things and publics participate in energy systems (Strenger, 2013; Throndsen & Ryghaug, 2015). However, the agency and politics of energy-related data have received little attention, and relatively little is known about the techno-politics of energy data (Hess & Sovacool, 2020).
The rise of big data and algorithmic networks in residential grids is especially interesting because household energy use and grids cut

across the public and private spheres (Hess & Coley, 2014; Chandler 2015). What is more, data-driven management is entangled with ethico-political questions about privacy, technocracy, and hackability (Kitchin, 2014). This not only relates to the politics of information flows, but also to the material politics of digital data (Bulkeley, McGuirk & Dowling, 2016; Bates, Lin & Goodale, 2016). Following Von Schnitzler here, I argue that adequately understanding smart homes, and their data, requires examination of "the very design, [as] such technologies are scripted with, and come to reflect, specific ethico-political projects, targets, and expectations" (2013: 672). Focussing on the production and circulation of smart home data in relation to grid management "opens up new understandings of the stickiness of the *status quo*, how unequal relations of power are (re-)accomplished" (Jensen, Cashmore & Späth, 2019: 2).

## Focus and outline of the paper

This paper examines the politics of smart home data in relation to grid management, addressing two interrelated questions: How are big data of smart homes *produced* and how do they *travel*? And, who is *empowered* by this data production and movement? It particularly looks at the ways in which a specific type of smart home produces digital knowledge about 'energy peaks', and how this knowledge moves through different sites and intersects with particular techno-political strategies. The notion of politics here does not refer to 'conventional' politics related to public demonstrations or formal policy negotiations. I follow Von Schnitzler, who advocates a 'micropolitical' understanding in which data technology "itself becomes a political terrain for the negotiation of moral-political questions" (2013: 671). The politics of energy data, then, refers to the ways in which energy data are created, as well as specific ways in which these data are employed politically. Energy data, in the context of smart homes, are expected to reassemble socio-material relations between households and grid management.

The paper is structured as follows. First, it briefly discusses the broader technological and societal context of smart homes in relation to grid management. It highlights how energy-managing smart homes integrate smart devices, and emerge as socio-material arrangements with the capacity to monitor residential energy patterns. Second, it examines recent insights from STS and energy research on big data. Informed by the concept of *data journey*, developed by Bates et al. (2016), it then proposes an 'energy data journey' approach as a socio-material (or rather cyber-physical) sensibility of the production and movement of energy data, and their micropolitical dynamics. The proposed analytical approach emphasizes: (1) the production of energy data; (2) their movement and mutability; and (3) the empowerment of specific actors and techno-political strategies. Third, the paper presents the empirical case of a Dutch-Belgian pilot project called Standard Grids, Smart Homes (SGSH) that has designed and tested a particular energy-managing smart home (a Home Energy Management System, or 'HEMS'). The methods used for this case study are presented in the case section. Adopting an energy data journey approach, the case illuminates in detail how smart home energy data are produced and travel. Energy data and household profiles are created and move through different cyber-physical locations: sensory devices, household appliances, bodily practices, computational software, and energy monitors. Specific data profiles are integrated and aggregated, with the strategic aim to monitor 'acceptable' grid parameters semi-automatically. The use of these 'home energy profiles' mostly contributes to neoliberal energy management, empowering high income households with self-monitoring tools, grid operators, and commercial companies that seek to develop smart home products.

Finally, the paper argues that an energy data journey approach contributes to STS, enabling researchers to reflect critically on the agency and politics of energy data as employed in various smart energy projects. As multi-actor projects involving 'smart energy' become omnipresent (smart grids, homes, cities, countries [Strengers, 2013]), such an approach has academic, policy, and social relevance. The final section also reflects on the cyber-materiality of energy data and the techno-politics of energy data more broadly.

## Smart homes and grid management

In the last couple of years, smart grids, smart meters, and smart thermostats have offered new ways to manage residential energy. These technologies can be programmed to execute specific semi-automated task, such as monitoring grid peaks loads, visualizing household energy use, and maintaining a comfortable home temperature. For example, smart meters, as adopted in many countries, allow real-time measurements of household electricity (kilowatt-hours) or gas consumption (M3). For grid operators, these measurements provide many more data points than before. As a result, local consumption patterns and peaks are rendered visible in much more detail (Van Dam, 2013). Smart meters are not neutral devices; the levels of detail serve specific techno-political strategies (Von Schnitzler, 2013). Fine-grained residential energy information can, for instance, contribute to better monitoring to safeguard trustworthy and affordable energy for all connected households. Consumers are, supposedly, also able to monitor their own consumption and make more informed choices about their energy use. Data-driven meters enable consumers to reduce 'excessive' electricity use, saving money and electricity, sometimes by as much as 15% (Darby, 2006).

### Integrating devices: smart homes and HEMS

Next to smart meters, other devices have been developed that are also able to communicate digital information. The combination of sustainable micro grids and home batteries, for example, allows households to utilize their own solar energy directly (during sun hours) or indirectly (when this energy is captured as stored capacity); grid operators are also interested in local storage capacities, which accommodate decentralized energy infrastructures, reducing residential peak loads. Relevant to energy consumption, digital capacities are incorporated



into household appliances, such as washing machines, tumble dryers, dish washers, and e-boilers. Smart home devices can be remotely controlled with apps, creating a personalized system with self-learning algorithms. All these energy technologies and smart devices have been designed and developed in relatively separate markets.

In recent years, however, energy production technologies and domestic appliances have gained the capacity to 'communicate', including with each other. An important integrative development is the rise of the smart home, or the Home Energy Management System (HEMS). There are many types of HEMS available on the market (Zhou, Li, Chan, Cao, Kuang, Liu & Wang, 2016). They all serve different socio-political purposes, which also depends on the integration of particular devices. Some HEMS optimize heating, for example, by connecting a smart thermostat to an e-boiler and a mobile app via the internet (e.g. Nest Learning Thermostat). This moves away from manual heating to allow semi-automated and personalized heating in order to increase comfort and convenience. Other HEMS optimize lighting and home security (taking over manual lighting) by integrating smart lighting devices, mobile apps, displays, and voice recognition (e.g. BrilliantSmart), while yet others optimize energy efficiency, energy autonomy, and environmental sustainability. In the case of the latter, which is the focus of this paper, using smart meters only 'simply to measure' energy consumption does not suffice. More technologies and software are required in order to monitor and manage other household electricity flows. All these types of 'HEMS data' can then be connected to smart appliances, such as smart white goods and smart e-boilers, and be programmed to utilize 'your own' solar energy. An important part of such HEMS is the computational software that integrates data and provides automated feedback about, for example, off-peak tariffs or the self-produced energy availability. In addition, the role of users and their household routines cannot be isolated from energy monitoring devices and HEMS (Shove, 2014). Even though smart homes are 'automated', the way consumers respond to automated feedback is a crucial part of the broader socio-material arrangement (Verbong, Beemsterboer

& Sengers, 2013; Hargreaves & Wilson, 2017).

The advanced integration of these HEMS have a clear potential for grid management and broader energy transition. As Zhou et al. suggest, it "leads to a fundamental transition for modern energy management systems from traditional centralized infrastructure towards the cyber-physical HEMS" (2016: 31). The term 'cyber-physical' is significant here, as it emphasizes that HEMS data should be understood as embedded in a complex socio-material network, linked to material devices, human conduct, automated data management, and particular socio-technical strategies. Before zooming in on an empirical HEMS case, in which energy data play a crucial role, it is instructive to understand conceptually how energy data are produced and transformed into moveable objects that serve specific techno-political strategies.

## Conceptualising energy data and their journeys

Long standing STS and sociology-informed research on energy has suggested that energy technology is socially and culturally embedded (Nye, 1990; Hughes, 1993). Recent scholarly work on smart energy technologies (Schick & Winthereik, 2013; Strenger, 2013; Throndsen, & Ryghaug, 2015), social practices related to energy (Shove & Walker, 2014), and power dynamics of energy regimes (Boyer, 2014), has examined the socio-technical and normative characteristics of smart energy technology (Silvast, Hänninen & Hyysalo, 2013). Yet, while these studies provide useful insights about the social and political entanglements of energy technologies, relatively little attention has been paid to the specific role and use of digital energy data from an STS perspective (Verbong & Loorbach, 2012; Bibri, 2018). Importantly, Hess and Sovalcool (2020) argue that, in the period between 2009 and 2019, STS-informed energy research has approached energy in different ways, identifying four STS perspectives: (1) cultural analysis, concerned with sociotechnical imaginaries and expectations; (2) policy analysis, focussing on risks and standards; (3) public participation, highlighting expert-public relations and mobilized publics; and (4) sociotechnical



systems, including the politics of design and the role of practices and users (Hess & Sovacool, 2020: 7). Nonetheless, although some STS work highlights how things and publics play a role in smart energy networks, the specificity of digital data seems to take a backseat.

### An energy data journey approach

This, however, does not mean that energy data should be regarded as separate from energy technologies. In a broader sense, big data as symbolic matter are deeply entwined with physical infrastructures (cf. Dourish & Mazmanian, 2011), while energy-related digital data are expected to play a role in all perspectives, as pointed out by Hess and Sovacool (2020). Energy data are linked to software systems, physical devices and infrastructures, regulatory norms, and cultural practices. Specific uses of energy data, then, can also play an important role reassembling these relations. In this paper, I argue that energy data should be understood as 'cyber-physical' entanglements that have the capacity to make and remake energy infrastructures in particular ways (Zhou et al., 2016). Therefore, to highlight how energy data come into being, how they move, and the strategic work they do, I employ a *data journey approach,* as proposed by Bates, et al. (2016). Even though these scholars do not explicitly refer to 'energy data', their understanding of data movement is instructive for the purpose of this paper.

Bates et al. (2016) present a conceptual understanding of what they call the cyber-physical 'life of data' as they move though time and space. Data, in this sense, transform as they move from their "initial production through to re-use in different contexts" (2016: 2). In fact, knowledge reproduced elsewhere is never duplicated, rather "repetition is concerned with the production of novelty, even in situations where 'things' appear to repeat in the image of the 'Same' or the 'Similar'" (Aroles & McLean, 2016: 538). The metaphor of 'journey', therefore, is significant, as it characterizes moving energy data: an assumed starting moment, the figurative 'luggage' it has while moving (information about energy), and constantly changing socio-material environments. Drawing from the methodological notion of 'journey' as employed in earlier cultural studies (e.g. Sheller & Urry, 2006), a data journey approach puts emphasis on

> [...] diverse social worlds that are interconnected, in part, by the journey of data through and between different sites of data practice, with the intention of illuminating the concrete ways in which evolving socio-cultural values and material factors cohere over time to create the socio-material conditions that frame activities of data production, processing and distribution and resultantly influence the form and use of data and their movement across infrastructures. (Bates et al., 2016: 2)

Importantly, a data journey often does not follow a linear path from A to B, but is altered, blocked, replicated, moulded, and reused in different ways. A data journey, therefore, can be said to consist of smaller and interconnected journeys. Based on meteorological data, Bates et al. (2016) inductively propose a set of analytical dimensions to a data journey approach: (1) the constitution of digital data objects; (2) cyber-physical data friction and shifts in patterns; and (3) the mutability of digital data (Bates et al., 2016: 6). In this paper, the latter two aspects are combined, as I think it is useful to analyse data movement in direct relation to mutability and repurposing of data. This sheds a more comprehensive analytical light on the digital-physical travelling of energy data. Furthermore, since this paper also investigates how energy data is linked to the reassemblage of socio-material relations in terms of power and empowerment, I add the following question: how do data and data travelling *empower* specific actors and techno-political projects? (cf. Von Schnitzler, 2013; Fox & Alldred, 2016). Below, three analytical aspects of an energy data journey approach are presented in the form of guiding questions for empirical examination.



1) **Cyber-physical constitution of energy data**
   How are specific energy data points created? What knowledge do these data represent? What are the characteristics of these energy data in terms of accuracy, timing, and measurement?
2) **Cyber-physical data movement and mutability**
   How does energy data move through specific physical-cyber settings? What actually enables and restricts the movement of data? How do practitioners repurpose and adapt energy data, as data move between sites? In what way do cyber-phys ical settings force energy data to hold their original shape, or adapt?
3) **Strategies and empowerment of specific actors**
   How do energy data and their movement empower particular actors? Which techno-political projects and strategies are mobilized and strengthened by energy data?

These analytical building blocks do not follow a specific sequence. Rather, they shed analytical light on how energy data journeys unfold, and guide the proposed assessment of the empirical smart home project.

## Empirical case: energy data journeys in the SGSH project

The sections above presented the societal context in which smart homes and HEMS have emerged. In 2015, Dutch and Belgian electricity grid operators initiated the so-called Standard Grids, Smart Homes project (SGSH) within a Dutch subvention, supported by a Dutch government programme to stimulate energy innovations and economic development. The SGSH project sought to make households more energy autonomous (maximising the use of local production and storage capacity), and less dependent on 'the grid'. As such, the project mainly utilizes smart homes for grid management purposes. As will be elaborated below, this is directly informed by considerations of finding a cost-efficient digital alternative to traditional (costly) public investments in 'wires and cables'. As well as three grid operators, a technology supplier and two research institutes participated in the project. The rather techno-scientifically driven project has designed and developed its very own type of HEMS. This type utilizes a low capacity household-grid connection (e.g. 6, 8, or 10 ampere instead of 25 or higher), while safeguarding sufficient electricity supply and 'normal comfort' by optimizing local production and storage capacity. In this way, the grid serves as a 'backup system', and stops being the prime supplier of electricity. The 'thin' line between the grid and homes is balanced by a relatively self-sufficient residential energy system. In addition to the technical development of the HEMS technology by technicians and engineers in the laboratory setting (however, without the involvement of actual users), the HEMS was 'tested' in actual households in 2017. The project partners and their expertise employed predominantly technical and computational software knowledge about energy infrastructure, power balancing, and data-driven applications. After a period of designing and 'lab testing' the HEMS (April-August 2017), they were physically installed in 16 Belgian and Dutch homes for 'field testing'. HEMS software was programmed and connected to the cloud, so that software developers could monitor the home energy use patterns of participating households.

The selected Dutch and Belgian households are located in three areas associated with the regional span of the three grid operators. The householders can be considered 'friendly users' since they already have solar panels and are willing to participate in the pilot project. Some have an electric vehicle or have participated in previous energy pilot projects. All 16 homes are privately owned and located outside densely populated urban areas. In terms of demographic characteristics, the users are between 35 and 66 years old, 65% men, and 70% higher educated. Most householders' professions are in domains such as consultancy, health care, or education and/or have a technical background (a couple are retired). The main objective of the field test was to assess if households can manage to stay within the limits of a low capacity grid connection (6 - 13 amp.) and rely on the HEMS without losing 'normal' levels of



energy use, hygiene, convenience, and comfort. This particular HEMS (embedded in the SGSH project), as an actor-network through which energy data are produced and circulate, serves as the empirical case to examine how energy data are produced, and how they travel and empower.

## Methods

The SGSH stakeholders were interviewed in a semi-structured way between the fall of 2016 and the summer of 2018 (almost the entire project duration). These direct project actors include the Dutch and Belgian grid operators, technology suppliers, software developers, and professional advisors. In total, I conducted 16 interviews with them, with an average length of about 60 minutes. Some of the interviews were a bit shorter (about 30 minutes), while others had a longer duration (up to 90 minutes). In addition to these interviews, empirical insights were derived from stakeholder workshops, field notes (visiting the lab and the households), as well as aggregated HEMS data. After the 2015 HEMS installation, I also approached the 16 households multiple times for interviews and digital surveys over the course of one year (summer 2017 - summer 2018). Interviewing and surveying the households every three months was useful to assess potential differences in how users adopted the HEMS in different seasons (e.g. temperature differences, number of sun hours for solar energy). Of course, this also enabled mapping any changes in experience and impact of the HEMS over the course of a year. The semi-structured interviews with households (in total 32 interviews, both physical and digital) were sometimes conducted with multiple household members. The interviews with HEMS users had an average duration of 60 minutes (some of which took about 90 minutes). In addition, I offered households a 'digital diary' to note down any HEMS-related experience or reflection between interviews and surveys. These (mostly qualitative) empirical materials have been analysed with a coding method (combining axial and *a priori* coding [Saldaña, 2015]), by categorizing empirical materials in accordance with the three analytical building blocks of the energy data journey approach (see above). The analytical dimension of the operational guiding questions enabled the clustering and examination of the empirical materials, and proved flexible enough to allow the inclusion of inductive empirical details, while taking into account the main analytical foundations of the data journey concept.

## 1. Cyber-physical constitution of HEMS data: creating home energy profiles

Before actual HEMS data points emerge as tangible energy knowledge objects, a process of problematizing peak loads takes place. Significantly, in the SGSH project, challenges associated with the residential energy sector were framed in such a way that Dutch and Belgian physical electrical grids remain ‘standard’, while homes and households became subject to energy ‘smartification’. In a broader sense, the physical energy technology and infrastructures (cables, wires) were put in the ground decades ago, and now needed to incorporate accurate digital data for better grid maintenance and management (interview with advisor on grid management, 1 November 2016). As part of a more general residential grid management concern (see above), this project then needed more detailed information about household energy flows. Often, grid operators mention the analogy of traffic jams and finding ways to avoid them. Peak loads in the residential grid work in a similar way, there are consumption peaks in the morning and in the evening, while there is ample local solar energy available in the afternoon. The mismatch between these consumption and production peaks needs to be resolved from a techno-material grid perspective (by ‘shifting’ and ‘shaving’ these peaks). However, the home is still ‘dumb’, and does not measure or share appropriate energy data. A key epistemic challenge is thus to know consumption and production patterns at the level of individual households, and then try to create an automated solution to allow the households to consume self-produced energy (which often includes a home battery to store and consume it). Problematizing household energy, then, is a *conditio sine qua non* for the production of energy data points as strategic knowledge objects. Most households are invested in this problematization, as they would like to utilize ‘their own’ renewable energy as much as possible. However, in the SGSH project, grid operators are the main actors to problematize home energy, and the lack of knowledge about it, for underlying grid management purposes. As one grid management actor put it, “The issue is not the technology, but the data” (interview with grid management actor, 20 September 2016). So, before actual data can be produced, there is a grid management need to produce home energy data.

The digital capturing of home energy flows, then, is done in different ways. The smart meter already provides much more information about energy consumption than just a few measurements a year (interview with advisor on grid management, 1 November 2016). Furthermore, the HEMS measures solar energy production, storage capacity, and the state of charge of the electric vehicle. These additional measurements - often based on an average of 15 minutes - produce huge amounts of data points that are algorithmically plotted to assess what I call ‘Home Energy Profiles’ (HEPs). Even though the category ‘HEP’ is not explicitly used in the project (although sometimes the term ‘load profiles’ is used), energy profiles are part and parcel of the HEMS and the broader SGSH project. HEPs represent particular energy flows associated with home devices or energy technologies. The SGSH project employs a wide range of HEPs. First, there are those associated with the local *production* of energy (from solar panels). In the cases of excessive solar energy production, electricity is injected ‘back’ into the grid, which then creates problematic production peaks for grid operators. Second, there are HEPs related to *consumption*, such as using a washing machine, dish washer, vacuum cleaner, electric kettle, induction stove, laptop adaptor, and so on. Again, excessive energy consumption can create ‘problematic peaks’, which may lead to grid disturbances, or brown-outs and black-outs. The smart meter is a crucial monitoring device here, as it captures all household electricity consumption as 'data', in terms of kilowatt-hours. And third, HEPs can represent the stored capacity of home batteries. All these flows are measured and processed as specific and identifiable data and profiles. There are multiple HEPs, designed to capture different energy flows, which are anything but static and stable units: they can be linked, integrated, and aggregated so as to provide a more 'complete picture' of the energy flows of one or multiple households.

## 2. Cyber-physical data movement and mutability: travelling energy profiles

The HEPs in the SGSH project are quite dynamic, as they move from one cyber-physical place to another. An important 'starting point' is the actual place where data points and HEPs come into being, which can be anywhere in a home and its digital connection to the HEMS: the living room, the rooftop, the kitchen, or an attic. Energy consuming practices, but also energy production and storage, are sensed and captured as relevant data points. Radiant light and heat, and social routines (cooking, cleaning), for example, are translated and digitally represented into '15-minute averaged data points'. Then these data points become patterns and turn into particular HEPs (see above). The use of 15-minute averaged measurements is a clear indication of translation from the physical to the digital. In the SGSH pilot project, HEPs are mostly used for grid and technical experts 'behind the scenes', that is, for monitoring household energy patterns (even at the level of clicks and duration of observing energy feedback by users). Next to the electronic cables and cyberspaces involved, HEPs travel further, from the households to the buildings and SGSH hardware (of software developers and grid operators), both in the Netherlands and Belgium.

A clear example of a travelling HEP (as mutable object [Law and Mol, 2001]) is the integration of specific HEPs: from singular energy patterns to a composite HEP, exemplified by the 'storage capacity profile'. Storage capacity, in this profile, refers to the 'state of charge' of the home battery. However, in a the smart home configuration, the home battery's profile is connected to other physical devices and their respective digital profiles (solar panels, the oven, state of charge of the electric vehicle). If, for instance, a consumer uses the oven to make dinner during a local energy peak hour (e.g. 6 pm), in order to avoid using grid energy, the smart home tries to utilize energy from the home battery which was charged by solar energy earlier that day. In other words, the digital storage capacity profile is entangled with different energy devices and socio-material household routines. Interestingly, the (re)charging itself is done by the HEMS algorithms, written by the SGSH project software engineers. The HEMS computational architecture calculates, monitors, and integrates a huge number of energy data points. Such integrated calculations facilitate the automated responses of the HEMS to optimize sustainable and autonomous energy use, linked to the overall SGSH project purpose of respecting low ampere grid limits. An advisor on grid management mentioned that even though information management has been around for years "we now have to help people [grid operators] with identifiable patterns" (interview with grid management actor, 1 November 2016). In this context, an interesting example of repurposing would be in elderly health care, as one stakeholder mentioned. If, for instance, energy consuming routines of an elderly patient are monitored and a daily pattern is interrupted (e.g. an expected electricity peak that represents making morning coffee remains absent), then a smart energy technology could alert a care worker to check on this person (interview with software developer, 9 November, 2017). This potential new data journey in a health care setting illustrates not only the potential reuses of energy data, but also its socio-material situatedness. The same holds for potential journeys in which HEMS data is used in a digital energy-sharing platform.

In the SGSH project, data journeys are neither smooth nor neutral cyber-physical trajectories; there are specific thresholds and limits within which energy flows should be maintained. The design of the software architecture serves grid balancing and management purposes. In the case of the battery profile, for example, the limits set refer to charging and discharging parameters. These limits are programmed, so that the battery does not utilize its full potential, and contains an extra buffer for extraordinary times. The limits can be adjusted according to season, as the winter requires more battery capacity because there is reduced solar energy availability and additional heating requirements. These energy profiles are linked to the algorithms that are programmed to respect grid limits, both injecting electricity into and consuming electricity from the grid, design choices that are entangled with socio-political questions. During the SGSH project, questions emerged about the roles and responsibilities of actors vis-à-vis 'controlling' individual solar panels or battery capacity (interview with grid management actor, 2 November 2016). What if, for instance, there is excessive solar production? Under which conditions can grid operators shut down solar production of individual households to prevent peaks in energy production? Or, can grid operators use individual storage capacities to solve grid problems elsewhere? These questions express the blurring of public/private boundaries associated with smart home data and profiles, situated in the context of increased energy decentralization. Instead of considering the (traditional) energy meter as the boundary between individual home autonomy and grid responsibilities, the HEMS (and its use of smart meters) shifts this boundary 'downstream' to the level of individual devices such as home batteries and smart washing machines. Ultimately, the rise of smart homes and digitalized energy information reframes a range of legal and political concerns about grid responsibilities and privacy.

As suggested earlier, the data journey approach suggests a 'journey', as an ongoing movement from devices inside the home to the aggregated monitoring devices of software developers and grid operators. However, in the SGSH project, energy data also move 'back' to the households. Energy feedback is a crucial aspect of informing and engaging users. HEPs are visualised for HEMS users with the aim of monitoring their own energy flows ('front end'). Most households consider the HEMS feedback an 'assistant' in terms of synchronizing energy supply and demand, thereby enabling them to become more



sustainable and autonomous, although in some instances, it was 'just fun' or 'a game' to play around with the new technology. HEPs 'return' to households in roughly two forms. First of all, there is a more or less intuitive user-friendly feedback system: a so-called 'traffic light'. An ambiance light (designed by Philips) has been modified and installed in all 16 households. It produces three signals; green, red or no light, which represent a simple message, namely, whether or not to change energy consuming routines (e.g. cooking, cleaning), in accordance with available and self-produced green energy. The colour-coded feedback is based on individual HEPs and algorithmic calculations and forecasting, a system that indicates that HEPs travel all the way 'back' to kitchens and living rooms, albeit in a different form. Interestingly, within these households there are all kinds of negotiations taking place vis-à-vis the energy feedback. Householders mention that some energy-consuming practices can be delayed, such as turning on the washing machine. Other routines are considered simply non-negotiable, such as cooking or vacuum cleaning prior to a family visit. As one user mentioned, "When you have guests and cook a lot, using lots of electricity, the red light can turn on. But, obviously, I won't stop cooking when that happens" (interview with householder 31 July 2017). In contrast to this micro-resistance to energy feedback, there are also many users who simply try to conform to the traffic light signals. In some cases this takes the form of moral discipline. As an older user told me, "Sometimes, in the morning … when I turn on the kettle and make some tea, I ask myself, is this actually acceptable? That's a strange feeling" (interview with householder, 19 May 2017). The anxiety this person experiences suggests that the traffic light associations (about being a 'good' or 'bad' energy consumer) can address both morals and emotions, which contributes to changing energy-consuming routines.

In addition to this relatively simple energy feedback, there is a more technical and detailed feedback format, called the 'energy dashboard', which provides information about a number of HEPs on a computer website. For instance, a graph can present 'monthly self-sufficiency', referring to ratio of using electricity from self-produced energy compared to electricity used from the grid. For most households, however, there is a limit regarding the level of detail they can process. As one user explained to me, “You should not constantly bother everyone with information, like, you’ve now used 1.01 hertz. You are going to need medicine for that” (interview with householder, 18 August 2017). Similarly, a grid management actor mentioned that consumers “just want to watch television at 8 o’clock, they just want to eat when they want to. So, it’s not the job of the consumer but of grid operators to offer the same level of comfort and optimize the portfolio of the customer” (interview with grid management actor, 20 September 2016). Feedback in the form of detailed HEPs is thus considered meaningful insofar as it provides tangible and useable information for prosumers.

The energy data that travels back to the household, interestingly, is entangled with social dynamics and negotiations among household members. As one HEMS user mentioned, “If the kids say, I want a grilled cheese sandwich, then I can say, maybe not right now [if the feedback lamp is red]. They might get a different type of sandwich instead [that does not require electric heating]” (interview with householder 3 May 2017). In some instances, traditional household (gender) roles and responsibilities are enacted or reproduced, which was the case in another household where I was told, “It’s difficult to convince my wife about this story [using the HEMS]. The big changes will be on her account, as she is a big energy user when she washes, irons, and cooks. She is the one who has to adapt” (interview with householder, 7 June 2017).

## 3. The strategic use of HEMS data: modes of techno-politics

HEPs do specific cyber-physical work. The overall techno-managerial aim of using energy data in the SGSH project is quite clear. As one grid management actor mentioned, “To give an example, if you have an electric vehicle and you come home in the evening at 7 pm, it would be a nightmare if everyone were to start charging their electric vehicles [creating huge electricity grid demands]” (interview with grid



management actor, 20 September 2016). Using self-produced and self-stored home energy – all measured, calculated and managed by the HEMS – could significantly reduce electricity grid peaks. HEPs are particularly interesting for grid operators, because they allow them to stimulate automation and save significant amounts of public money on traditional investments in physical ‘wires and cables’ (interview with grid advisor, 2 November 2016). Although most SGSH stakeholders claim that investing in physical energy infrastructures is much more costly than using smart solutions (such as smart homes), a few of them still argue that traditional grid investments could be more trustworthy and efficient (interview with grid management actor, 1 November 2016). Nevertheless, national and local energy policy can benefit from HEMS, as they have the potential to contribute to decarbonizing local electricity networks in the broader sustainable energy transition (Verbong & Loorbach, 2012). The HEPs that have been tested and developed in the SGSH project represent modernist techno-politics that provide cyber-physical ‘grip’ on an increasingly complex grid. It seems that the rise of such cyber-physical energy infrastructures can extend and fine tune existing physical energy infrastructures, thereby providing novel energy governing strategies (Boyer, 2014). Relatedly, for prosumers and users of such HEMS, it might be clear what is in it for them. Despite the relatively high initial investments of buying solar panels, a home battery, and smart appliances, energy data can empower them as it allows them to save money on their electricity bill and become more environmentally friendly and autonomous in terms of energy consumption (Darby, 2006).

Significantly, the political logic underlying the deployment of HEPs and energy managing smart homes more broadly creates opportunities to steer behaviour. First, the disciplinary work that HEPs seem to do is to allow grids to distinguish ‘good’ from ‘bad’ energy situations. HEPs produce very detailed information and graphs about energy flows, and when there is too little or too much consumption and availability. This holds for back-end HEPs monitoring low ampere grid limits (of both individual households and groups), but also for front-end HEPs (energy feedback in the home). Consequently, HEPs transform grid management practices by adding a layer of digital representations of household energy flows, and knowledge about problematic energy moments of injection and consumption peaks. Energy data related to finances and tariffs (e.g. euros saved) are particularly relevant, as has been shown in a different project; as I was told, “The difference between peak and off-peak tariffs has to be five times, in order to make consumers change their behaviour” (interview with grid management actor, 20 September 2016).

New forms of visualizing domestic electricity render knowable the kind of activities that are required to be a good ‘grid-respecting’ prosumer: for instance, moving washing activities to another day or even reducing electricity consumption. Without suggesting that seeing energy feedback automatically leads to different conduct, participating SGSH households do try to become more energy efficient. Ambient lighting and energy dashboards or apps, therefore, can be considered cyber-physical interventions that seek to change everyday energy use routines, including financial incentives that punish and reward. The use of HEMS is also tied to the promise of a low voltage grid connection, which is significantly cheaper for households. Many SGSH stakeholders think that this financial advantage could be interesting for the broader public as well (even through there are many technological, economic, and regulatory uncertainties).

Furthermore, the possible mainstreaming of HEMS resonates with consumer lifestyles that cultivate home comfort and convenience while ‘being green’. As some households suggest, the use of HEMS could even increase standards of living by augmenting the opportunities for households to become slightly more knowledgeable, energy autonomous, sustainable, financially aware, and tech-savvy. As Levenda, Mahmoudi, and Sussman (2015) argue, the rise of smart energy goes hand in hand with the neoliberalization of energy systems and practices, while the techno-commercial use of HEPs sits well with modern information and control systems. As I was told, “If the market received more accurate and detailed data, more than one index per year, it would be more



conscious about possibilities and business models” (interview with grid management actor, 20 September 2016). In other words, smart homes (designed for grid management) can be big business. What is more, in order to make HEMS more interesting to the broader public, they could potentially even receive financial compensation for contributing to solving the problem of grid operators (i.e. reducing and balancing local peaks) (interview with technical researcher, 10 January 2018).

The rise of HEMS data is associated with the development of new smart energy products and services for households, which can be (semi-)public or commercial in character. The public role of grid operators is especially significant as they are keen on safeguarding accessible, reliable, safe, affordable, and sustainable energy for *all* households (energy, or even the HEMS, could become a ‘public good’) (interview with grid management actor, 21 October 2016). As mentioned above, the Dutch government co-funded and supported the SGSH project as part of a broader strategy to stimulate economic development related to energy innovations, although this gives rise to risks associated with defining energy and energy data as commercial goods (e.g. selling energy data to third parties, decreased accountability). Furthermore, specific options are also explored in a ‘community model’ in which a virtual community of HEMS could self-produce and share renewable energy (interview with software developer, 7 December 2017). Such a community is ‘cyber-physical-geographical-legal’, since it is geographically local but also stimulated by European regulations and physical infrastructure, as well as by a HEMS-like digital platform (interview with grid management actor, 15 January 2018). One could argue that this resonates with the notion of energy democracy as a political strategy to empower citizens groups and local energy communities (Szulecki, 2018). For more commercial stakeholders, the SGSH project even works as an R&D innovation project. However, if energy data are produced and travel mostly due to financial incentives, it could become problematic, especially in cases where energy data are designed and controlled by a few or only a single commercial tech company (Kitchin, 2014).

During one of the stakeholder workshops, there was a discussion about whether households could also see more detailed information about their own energy profiles but the back-end energy profiles (this seemed to be the argument at least from professionals) seemed to be considered less relevant and too technical for householders. Yet, if energy data management systems are not transparent and accessible, they might undermine the trustworthiness and public character of grid-related energy data. As an alternative, a more hybrid techno-political strategy is explored in the SGSH project in which grid operators engage in (medium or large scale) contracting, or employ HEMS as part of a broader grid management repertoire to solve local grid problems (at the level of specific streets). In that scenario, only a few "problematic households" could be targeted by grid operators, who could install HEMS in those homes to solve a local grid problem (interview with grid advisor, 2 November 2016).

A final political issue related to the HEPs (in the SGSH project at least) is that they seem to benefit a small group of users. The HEMS are tested and adopted in particular rural areas, in households with higher incomes, higher education, energy-saving awareness, and an interest in energy autonomy. Consequently, an expanding gap might emerge between households that enjoy the financial, environmental, and informational fruits of HEMS and households without them (particular households in particular cities or districts). Most participating households and HEMS developers argue that this energy technology should become interesting for the broader public, highlighting, for instance, its money-saving potential and the need for regulatory standardization for accelerating market development (of whitegoods products and designs). If only frontrunners adopt a HEMS, it could create adverse effects. What if, for instance, only future HEMS users with higher energy capacity have access to lower energy prices on a structural basis than low income groups (interview with grid management actor, 1 November 2016)? This could unfold along the line of digital inequalities, the infamous digital divide, and intersecting socio-economic inequalities (Day, Walker & Simcock, 2016).



## Conclusion and discussion

This paper has discussed the cyber-physical life of energy data, in particular in relation to smart homes. Residential energy data are much more than just digital knowledge objects. The empirical case showed that they represent specific and highly dynamic socio-material measurements, updated every 15 minutes, strung together as energy patterns (which I termed 'HEPs'), and individualized yet transmittable. As Aroles and McLean (2016) suggest, the power of HEPs lies in their ability to re-emerge in novel contexts, that is, to be flexibly reconnected and become significant repeatedly. HEPs are standardized objects of knowledge about very particular energy flows, but can be merged, shared, repeated, replicated, and modified.

Although it was developed in relation to meteorological data, the data journey approach presented by Bates et al. (2016) was productive in assessing how HEMS data emerge and move through energy infrastructures. The study showed that during the establishment of data, a process of problematizing household energy peaks is conditional. The approach also showed that HEPs, as standardized yet highly flexible energy representations, fuse two "ontologies of social order" (Strengers, 2013: 8): the 'techno-rational' and the 'messy social'. Thus, energy data should be understood as cyber-socio-physical entanglements. This contribution shows that energy data journeys are cyber-material, and highlights how specific energy data travel between socio-material places (Bates, 2018). HEPs travel via cooking practices, smart meters, washing machines, energy markets, computer hardware, databases, clouds and computational software, laptops in the living room, gender roles, and weekly laundry practices. Importantly, whenever energy data move, they are transformed, as they gain new relevance in different configurations. Energy management and feedback, then, constitute a circular movement of automated energy monitoring, constant digital updating, and shifting energy routines. Importantly, energy data movement re-assembles existing socio-technical energy relations between prosumers, grid managers, and other actors.

The energy data journey approach also proved to be fruitful in highlighting the techno-political strategies associated with their production and movement across places. So, what did the approach offer in terms of considering the smart home and energy data as "political terrain for the negotiation of moral-political questions" (2013: 671)? How are energy profiles used, and who wins and loses? Clearly, the use of big data in residential energy infrastructures is driven by a profound techno-scientific, even anti-political, commitment to managing socio-technical systems (Strengers, 2013; Sadowski & Levenda, 2020). Not only avoiding public discussion, but also steering away from public investments in physical grids by grid operators, the neoliberal approach embedded in the SGSH project focusses on a digital grid, delegating responsibility to energy-shifting households. Most of these households already participate in energy efficient practices (as friendly users), but without playing a significant role in residential grid management. This techno-neoliberal strategy to govern the grid employs energy data in a hybrid public-private network, rendering individual households responsible for investing in costly energy technologies and smart devices. I argue that smart home data empower three groups, all in particular ways: smart home prosumers, grid operators, and commercial energy (tech-)companies. Prosumers gain more decision-making power over their own energy system, while grid operators gain more fine-grained insights, storage capacities, and grid management capacity. In market-driven energy sectors, smart homes allow commercial companies to develop innovative physical and digital energy products. The energy data journeys themselves, and the values they produce during such movement, are geared towards making already powerful actors in the energy regime more powerful (all three groups). Simultaneously, such smart home technologies seem to reproduce societal inequalities, especially disempowering low-income households, and groups with little affinity for technology and sustainable energy.

These journeys and their associated accumulation of power, however, are not entirely fixed. The potentialities of energy data for digital health care services or energy-sharing platforms, as we have seen, point to the techno-political mutability of such data. This results in moral and political questions about energy data ownership, and how individualized energy profiles are related to surveillance, commodification, and hackability (Kitchin, 2014). To be sure, it is rather unclear whether one would still own the data recording one's own energy routines in smart home projects implemented on a large scale. At the same time, the energy data journey does not have a fixed meaning or final location. This means that repurposing household energy data points potentially resonates with more democratic strategies that would democratize renewable energy systems (e.g. community ownership, energy cooperatives). These techno-political aspects of energy data are particularly interesting, as they relate to different political narratives in the broader sustainable energy transition in which, no matter the scenario, the political uses of energy data – such as moving and changing cyber-physical 'objects' - cannot be underestimated, requiring continued scrutiny from researchers, software developers, and policy makers.

The proposed energy data journey approach is particularly fruitful given the world-wide mushrooming of (sustainable) smart energy projects. Energy data are expected to be co-produced and adopted by grid operators, engineers, commercial companies, policy makers, and citizens. An energy data journey approach tailored to (green) energy regimes, as proposed in this study, contributes to STS-informed energy research. STS scholars, in particular, should engage in critical research on the micropolitics of energy data, and the role of big data in the energy transition more broadly.

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# Enlivening Data
## Reassembling Life in Post-Fukushima Japan

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## Abstract

This article is based on ethnographic research conducted in the wake of the Fukushima nuclear disaster in Japan in 2011. The paper analyses how the interplay between the state, the citizenry, and particular radiation technologies defined the shifting boundaries of safety after the fallout and its disruptions. Drawing on James Scott's notion of legibility, I analyse the Japanese state's deployment of dosimeters, maps, and monitoring posts, which generated myriad data that were translated into the legibility of radiation, whereby the enactment of new boundaries of safety and the remaking of the Japanese state became feasible. Previous studies of the Chernobyl and Fukushima disasters indicated that ordinary people, if not precisely victimized, have limited capacities to make their claims and confront powerful authorities. In Iitate, I trace citizens' responses to incorporating accessible and affordable technologies that rendered the state's boundaries of safety leaky, immanent, and continually renegotiable, whereby ordinary people are empowered to enact alternative ways of seeing and perceiving radiation. I use the notion of 'enlivening' to differentiate citizens' data from those produced by the state and suggest how the environment has re-emerged as an experimental field generative of new relations between villagers' lives and a diversity of things and organisms.

**Keywords**: nuclear disaster, Fukushima, environmental governance, radiation, technology and citizen.

## Setting the Scene

Everything was shaking, as if it were crumbling into fragments before Sugiyama-san's very eyes when the earthquake struck on March 11 2011. Experiencing the largest earthquake he had ever encountered, Sugiyama-san felt like the world was coming to an end. Finding themselves without electricity on the first night following the massive tremor, he and his family were in complete darkness, learning by listening to the radio of an evacuation announcement for anyone living within a 3km radius of the Fukushima Daiichi Nuclear Power Plant (FDNP1), which had been hit by the tsunami approximately an hour after the quake. Sugiyama-san learned too late that a 15m high tsunami had flooded four reactors, one of which had started a core meltdown by the time night fell.

After electricity was restored on the fourth day, Sugiyama-san was finally able to watch the live broadcast of the hydrogen explosion at Unit No. 3. He still had no clue, however, about the directional change in the wind that was bringing the radiation plume towards Iitate's mountainous northwest location. For villagers in Iitate,[1] the 'tsunami' did not come from the Pacific Ocean but, rather, from the sky above, to ravage the epicentre of the human-made infrastructure that they had been assured was '100% safe' (Jones et al. 2013; Dusinberre and Aldrich 2011).

The Japanese state disappeared in Sugiyama-san's hour of need. Can his grandchildren play outdoors? Should the family evacuate? When can his 90-year-old father touch the grass outside their home? In the unfolding of the nuclear crisis, mundane questions like these were left unanswered when the villagers confronted the official scientists parachuting in from cabinet-level ministries and the prefectural government. They told Sugiyama-san at the village office that it was safe only in Iitate, and that he should "learn to fear correctly (*tadashiku kowagareba ii*)". Yet, in less than three weeks, Iitate too was no longer safe; Sugiyama-san was ordered to leave his home, which by then was inside the Preparatory Evacuation Zone. This article addresses how the interplay of actors including the state, the citizenry, and dosimetric technologies defined the shifting boundaries of safety, leaving Sugiyama-san's home beyond the state's protection with his concerns—both known and perceived—ignored.

Such fraught scenes articulate the fault lines between the Japanese

[1] Iitate is located in the Abukuma mountain range in Fukushima prefecture, northwest of FDNP1. Three-quarters of the village is forested land at an average altitude of 450m. It was home to a population of 6,000 people who were scattered over 250 square km of mountainous, forested terrain. For subsistence, villagers produced rice, vegetables, and flowers while raising cattle for beef and milk.

state and Iitate's villagers, underlying official responses to the fallout and associated policy decisions, which at first glance were not new. Adriana Petryna (2002), in her study of the Chernobyl accident, illustrates how the making of the Ukrainian state was intertwined with the containment of the fallout, which involved the incorporation of radiation data into the process of biologically monitoring and regulating at-risk populations (see also Beck 1992; 1999). While the state sought to conceal and shift its liability, limited access to data about personal doses forced the irradiated citizens to explore strategies through which to struggle with welfare and survival. Olga Kuchinskaya (2014) addresses how, in Belarus, state ministries produced authoritative representations of imperceptible radiation to manipulate public understanding of the health hazards and environmental risks. These studies highlight the victimization and incapacitation of citizens seeking to lay claim to knowledge about their irradiated bodies and polluted environments that have reinforced the dominance of the state over its citizenry.

In Japan, the failed promise of absolute safety and the chaotic emergency responses created widespread mistrust among citizens, and a crisis of legitimacy was imminent. As in Ukraine and Belarus, the state's compelling task was to restore its governance over the polluted environment in order to master the pressing social disorder (Agrawal 2005; Douglas 1966).[2] Yet the fallout pushed the limits of knowledge. Radiation released from a melted reactor core contains more than a hundred radioactive isotopes, of which only a few are found in nature. Iodine-131 sparked concern among mothers about the safety of children, whose thyroid glands were prone to absorb it (Kimura 2016; Slater et al. 2014). Tracing water-soluble cesium and bone-seeking strontium posed significant challenges to scientists and officials in assessing decontamination in the altered ecologies and new dynamics between carcinogenic radiation and citizens' bodies. Their trajectories in the food system reopened debates over the current science regarding low-level radiation (Brown 2017; Morris-Suzuki 2014; Stawkowski 2017).

The fallout was vast, not only in terms of the variety and quantity of radioactivity unleashed but also in terms of the ecological, social, and political consequences, which had multiple and unbounded effects on the pre-disaster infrastructure of protection and boundaries of safety that the state had developed and maintained. Tracking the radiation unleashed was very much an open and urgent question. Contrary to Ukrainians or Belarusians, however, what made the difference here was the capacity of Japanese citizens, in the face of the inevitable disruption, to produce alternative representations of radiation that defined an inhabitable environment—that is, the conditions of life—through portable technologies. Following Sugiyama-san's concerns, I address how ordinary citizens generated their own data, which provided a basis for disputing the official science and the legibility of radiation enforced by the state. I argue that, in Iitate, in the deployment of novel technologies, radiation data have enlivened the persistence of life in a way that has entangled villagers with the decaying but ineradicable radiation and with other lives that arrived or remained and proliferated after the fallout.

To analyse this process, in the first part of this article, I describe the deployment of makeshift technologies in the state's immediate response as it sought to objectify the disaster and orient the distribution of vulnerabilities (Bond 2013; Fortun 2001). I then discuss the digitalization of the monitoring network that brought the assessment of radiation risks into close correspondence with the boundaries of safety enacted during the crisis. These technologies, with the underlying science, generated myriad data that were translated into the legibility of radiation, whereby the remaking of the Japanese state became feasible.

Drawing on James Scott's notion of legibility, I take the techno-political infrastructure to constitute a process of standardization and simplification designed to produce a grid-like vision of radiation that would provide the state with "the capacity for large-scale social

2 What makes the task more compelling is the Japanese conception of the environment, which is closely related to the notion of cultured and engineered nature, i.e., the aestheticization and exploitation that work together to allow nature to reach its full potential (Kalland and Asquith 1997; Kirby 2010; Walker 2010).

engineering" (1998: 5; also see Jasanoff ed. 2004). To further illustrate the remaking of state authorities, I analyse the evolution of radiation maps, described by Kuchinskaya (2014) as 'formal representation[s]' that rendered imperceptible radiation pervasively visible not only in policy papers and science journals but also in social media and the daily news reports on people's everyday lives. Scott notes that these maps—as powerful representations that contributed to constituting the state's political power—"when allied with state power, would enable much of the reality they [state officials] depicted to be remade" (1998: 3; see also Anderson 1991).

Perhaps the official scientists whom Sugiyama-san met can offer us a glimpse of such a reality. "Learn to fear correctly" implied the presence of an authoritative way of 'seeing' radiation embroiled in perpetual uncertainty (Mathews 2011). During the unprecedented human-made disaster, citizens were asked to accept a new path to the persistence of life, envisioned by the radiation data and their effects: maps and other inscription devices (Latour and Woolgar 1986) that officials and scientists gradually obtained. In this sense, the legibility of radiation is the condition of a defendable environment, making a return to 'normal life' in a shared future possible. Yet the legibility of radiation was not implemented without resistance, as we shall see when citizens were forced to act using handheld dosimeters to gain knowledge about radiation exposure.

This article is based on uninterrupted ethnographic fieldwork conducted over 14 months from June 2016. After Iitate was reopened in April 2017, I stayed at Sugiyama-san's house, talking to would-be returnees and those already settled in other places, and driving around to talk with villagers who were struggling with new life circumstances shaped by radiation. Sugiyama-san was one of the earliest among the villagers to return and resume agricultural work in Iitate. During the six years of evacuation, he had joined a group of concerned citizens and scientists, mainly from Tokyo, to form a non-profit organization called Living Together with Fukushima (hereafter LiFu) to assist other villagers in the decontamination and monitoring of radiation as well as



in experimenting with new ways to practice agriculture in a radioactive landscape.

This article makes two interventions. Firstly, it contributes to the discussion of the interplay between the state, citizens, and scientists/experts during the disruption of a disaster like nuclear fallout. Previous studies have depicted that ordinary people have little access to technologies to make their claims and confront powerful authorities. The incapacitation of civil society is the assumption of these scholars when studying the making of the state and its governance over the citizenry. I argue that, through flexible technologies like dosimeters, citizens' early involvement enables not only alternative representations and understandings of disaster but also collaboration in ways of rehabilitating the contaminated environment and livelihoods that are unthinkable to state officials and experts.

Secondly, I ask what the enduring salience of data carefully produced by citizens like Sugiyama-san and members of LiFu means for our understanding of datum itself. In Iitate, beyond a fact given, data become a platform for villagers, citizens, and experts to build rapport; meanwhile, in messy and complicated ways, data reconnect a diversity of things and organisms with the returning villagers' livelihoods. I use the notion of 'enlivening' to shed light on the emergence of generative relations embedded in the very possibilities of Iitate's altered ecology.

## Official Science and Legibility of Radiation

Before the disaster occurred, the Japanese state had built radiation-monitoring infrastructure and put emergency response protocols in place to handle nuclear incidents. In light of the Three Mile Island incident and the Chernobyl disaster, the Japan Atomic Energy Agency (JAEA)[3] developed the System for Prediction of Environment Emergency Dose Information (SPEEDI) to keep the nation's operating nuclear power

[3] JAEA is a semi-government agency established in the 1950s to research the use of nuclear power (Aldrich 2008; Jones et al. 2013).

plants under constant surveillance. Radiation levels in the ambient environment, gaseous effluents emanating from plants' vent stacks, and waste heat water discharged into the ocean were monitored by detectors located around or on the periphery of all nuclear facilities. Risks of radioactive exposure were assessed by a dosimetric science with its root in the study of the health effects on people exposed to the radiation released in the explosion of two atomic bombs in Hiroshima and Nagasaki (Lindee 2016).

The SPEEDI[4] was designated to compile, during an accident, data received from the sensors and monitoring posts, as well as those transmitted from an emergency response system, to generate vital predictions regarding, for example, the movement of radioactive plumes and real-time dose assessments in radiological emergencies. Based on monitoring data and dose predictions, the radiation teams at offsite emergency centres were given the power to take charge of any nuclear emergency and make decisions to protect the citizenry (Chino et al. 1984; Misawa et al. 2008). Iitate was covered by one of the 22 emergency centres in the town of Ōkuma, located within a 5km radius of FDNP1. "Before the disaster, TEPCO [the operator of FDNP1] arranged two visits to the power plant, and all I had learned from them was that it was a safe facility; we weren't told what to do in case an accident happened," Sugiyama-san recalled. This safety myth was broken during the earthquake. On March 11, a power outage occurred at Ōkuma, resulting in the collapse of the entire system. The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) tried to use the SPEEDI without data from the emergency response system to run simulations that resulted in unreliable dose assessments and trajectory predictions regarding the radioactive plume (Nakajima et al. 2019; Povinec et al. 2013: 84-90).

The effects of the triple disaster—the earthquake, the tsunami, and the meltdown—and the immense scale of the fallout surpassed the

[4] Until 2011, the SPEEDI was operated and supervised by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and local governments, monitoring 54 commercial reactors at 18 nuclear power stations (FEPC 2020).



capacity of the legislated procedures and operations to manage the disaster. Disruptions in the SPEEDI and emergency response protocols created an urgent task for scientists, which was to estimate the size, scale, and movement of the invisible radioactive nuclides unleashed by the meltdown as quickly as possible: that is, to render radiation visible and thus legible.

The Nuclear Safety Commission (NSC), along with the JAEA, was assigned the task of revising the evacuation plan by Japan's Prime Minister. They deployed handheld dosimeters as a makeshift technology to produce radiation data they used to assess the fallout (MEXT 2011a). By March 25, the NSC had released the first map of cumulative radiation doses (Figure 3.1), building on two sources of data: the fragmented dataset recovered from the SPEEDI and those harvested by handheld dosimeters at sites where data points were determined by NSC and JAEA scientists. By citing and rendering these data points, a renewed bird's-eye view was articulated through the map that authorized the local emergency centres and officials to enact evacuation orders with apparently greater precision through redefining the boundaries of safety that had taken shape in April after dots (data points) on the map were connected to form contours (Figure 3.2 and 3.3).


Figure 3.1: The first map of cumulative radiation doses (NRA 2011a).

Notably, the MEXT, the ministry responsible for constructing maps, attempted to build new versions by extrapolation to connect the dots and create a contour map that produced a topographic representation of radiation. As shown in Figure 3.3,[5] for the first time after the disaster, Japan was demarcated into two zones marked by the red line. Inside the red line was the zone that later became the Preparatory Evacuation Zone, whereas the rest of Japan would be deemed 'safe'. The newly mapped borders were not finalized until the release of the airborne radiation map that replaced this semi-accomplished version.

*Figure 3.2: Dose rate map as of April 24, 2011 (MEXT 2012:1)*

*Figure 3.3: Integrated dose estimation map with a new border demarcating the forced evacuation zone (MEXT 2012:2)*

The first airborne monitoring activity was launched in April, during which time the MEXT and the US Department of Energy joined forces to survey by aircraft an area within an 80km radius of the nuclear power plant. The technology involved the installation of highly sensitive

[5] Paradoxically, this map, which was supposed to indicate the correlation between geography and radiation risk, was the only map that combined geography with radiology. Landscape details were subsequently erased in later versions.



radiation detectors to measure gamma radiation from a height ranging from 150-300m; data collected were then used to estimate the air dose radiation 1m above the ground. By connecting an aircraft with dosimeters, this spatial modelling scheme equipped the MEXT with airborne maps capable of zooming into the surveyed zone. The map was filled with data points without actual on-the-ground measurements. This technology enacted scalability (Tsing 2015) that marked a watershed in the competition over radiation map production between the MEXT and the citizenry. Meanwhile, the map produced the radiation legibility that empowered the MEXT to form a new terrain of administrative mechanisms and policies.[6]

Such mechanisms and policies were grounded on new conditions of the living environment enacted by maps and later the network of monitoring posts. After the airborne map was overlaid with coloured patches, Fukushima's landscape was flattened, with the border that demarcated villages, towns, cities, and prefectures redrawn to articulate a new emerging fact: the nuclear crisis had been contained in a clearly marked zone, to which Iitate and Sugiyama-san's home were temporarily condemned.

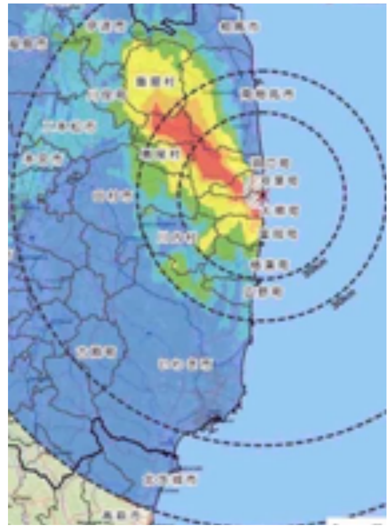

*Figure 3.4: The first airborne radiation map (NRA 2011b).*

[6] The first airborne radiation map was launched between April 6 and April 29 and finalized on May 6, nearly two months after the meltdown (see Figure 3.4). It covered the eastern half of Fukushima and, unlike the contour map, it encompassed the entire area within an 80 km radius, using the nuclear power plant as the centre. An early version was published on April 22 in national and local newspapers and other print media. Based on that version, the state declared on April 11 provisionally and April 22 officially that Iitate fell into the 'Planned Evacuation Zone', together with part of Minami Sōma City and the village of Kawamata. With the issuance of this order, villagers in Iitate had to move in accordance with the new orders from the state.

The airborne map has subsequently been widely circulated in official statements and policies, academic papers, and reports issued by discussion panels at international conferences and summits, as well as in the news, books in print, and video footage on social media; among Iitate villagers, the radiation map was taken as definitive and thus 'real'. Thus, the airborne map has become what Kuchinskaya (2014) calls a 'formal representation', serving further to stabilize the fallout as an object of environmental governance.

At the end of the nuclear emergency, the MEXT designed a new monitoring infrastructure to replace makeshift technologies, including the handheld dosimeters and car monitoring, to generate data for further analysis of the fallout (MEXT 2011b). Over 3,000 monitoring posts were installed Fukushima and 150 in Iitate; to enhance the transparency of information, not only were measurements displayed via LED panels attached to the monitoring posts, but data were also streamed to be compiled into new maps that would be accessible through the MEXT and Fukushima prefectural government websites.[7] Measurements in Sv/hr[8] are printed in local newspapers, reported on TV news programmes every day, and reviewed and studied regularly by experts at universities, state agencies, and official committees at the local and prefecture levels. These additional layers of inscription (Latour and Woolgar 1986) bolster the strength of the original inscriptions, producing a network that constitutes the continuing project of making radiation legible. Each datum was an index of the new radiation safety standard that bundled risk assessment and policy decisions concerning the nuclear fallout, with the relationship between the affected people like Sugiyama-san, the state, and its citizenry.

First, these inscription devices make it possible to disseminate new safety standards and the borders that have resolutely isolated Iitate from the rest of Japan. During the crisis, the NSC had drawn up two new standards to demarcate the affected area. With an annual accumulated dose above 20 mSv, the area would be designated as the 'Difficult-to-Return' zone. Underpinned and made possible by radiation data, bordering practices situated Iitate on the new administrative-political grid as an evacuation zone. When the borderland was stabilized by new boundaries, so was the homeland for most Japanese citizens; hence, monitoring is both productive and also conducive to holding Japan—the state and its citizenry—together. In other words, radiation maps and monitoring posts are salient as they help to make Japan as much as they are made by the Japanese state (Latour 1991; also see de Laet and Mol 2000).

Serving as a reminder of radiation risk, therefore, the infrastructure envisioned a future of hope that people's homeland and livelihoods would eventually return to normal, as the readings of the posts show no fluctuation but a uniform decline. Moreover, as the official response to the nuclear disaster shifted to public health and radiation risk outside the evacuation zone, along with the technological mediation that it necessitated, it became increasingly difficult to induce state officials or scientists to answer Sugiyama-san's questions, as his home had been deemed unsafe within the designated borderland, and thus was to be abandoned.

Second, while the state implemented newly defined rules and policies concerning a governable environment, the legibility of radiation was mobilized to shape the meaning of effective decontamination and restoration. In Iitate, the entire village was divided into two zones: one consisted of forest and woodland areas that covered 75% of the village and was left untouched; the other zone consisted of farmlands, roads, and residential areas in which radiation levels were deemed reducible below 20 mSv of annual external exposure. The former zone was

[7] Contrary to the high modernist regimes analysed by Scott, I suggest the Japanese state has enacted a more sophisticated kind of legibility. Alongside the technologies of simplification and standardization, public participation became constitutive of a new orderliness of the environment, and thus society, when data transparency was enforced through the internet and mass media.

[8] The sievert (Sv) is the unit of measure for the biological effects of ionizing radiation. The *effective* dose measured in Sievert (Sv/hr) is defined as the *possible damage* to human tissue from a given absorbed dose. Before the disaster, Japan measured radiation in Gray (Gy/hr), defined as the energy *absorbed* by tissue over a specific duration of time. Early monitoring charts and tables could still be seen to report radiation in Gy/hr. This change hints at the shifting frame of reference that focuses on humans and the health risks to the population.

excluded from the risk calculus and official statistics of the Ministry of the Environment, thus rendering it 'twice invisible' (Kuchinkaya 2014).

In the restoration of farmlands, local knowledge of agriculture was also made invisible when the MoE assessed health risks primarily through radiation data produced by the monitoring infrastructure. Farmlands were decontaminated by stripping the topsoil using excavators, which was then loaded into flexible container bags, commonly known as 'black bags' (MoE 2013). Scrapped topsoil was replaced by infertile pit sand that villagers called 'guest soil', literally wiping out the web of relations that villagers had intimately cultivated through Iitate's ecology for decades. Ironically, as the environment was deemed governable, Sugiyama-san found it not habitable, saying, "No, this is not home, home is not yet ready."

## 'Doing Science Together': Contending With the State Through Citizens' Own Data

Sugiyama-san and Japanese citizens were as anxious as the ministry officials to obtain radiation data for the sake of their health and safety.[9] After the Prime Minister declared a Nuclear Emergency Situation on March 11, as Morita et al. noted (2013), citizens started spontaneously to measure and monitor the radioactivity in their communities. On March 13, a Tokyo-based video director used his Twitter account to call for assistance in constructing a Google map that incorporated individual measurements. He also downloaded data provided by the government-installed monitoring posts that were available on the MEXT's website and added those data to his map. This initiative quickly went viral as more citizens engaged in foraging hundreds of data points from multiple parties and some experts retooled skills (Miyazaki 2014; Riles 2013) that they had long since mastered, such as data visualization using Google maps, to produce citizen-sourced radiation maps (Abe 2014; Brown et al. 2016).

The complexity and multiplicity of the data and their sources stood in sharp contrast to the scarcity of available data on the MEXT's website. Morita et al. argued that the 'heterogeneity' of maps (Law 1987) facilitated the emergence of new standards of radiation monitoring,[10] as well as the co-production of what counted as valid data and the location of a safety/danger border. With their handheld dosimeters, citizens were empowered to evaluate the plausibility of official data and thereby their risk assessments. Yet the story did not end there. Other radiation-monitoring networks mushroomed in Japan, with some still operating today.

For example, Kimura (2016) and Sternsdorff-Cisterna (2018) discussed Japanese mothers across prefectures who mobilized to monitor food safety to protect their children. Traditionally playing the role of the caregiver, mothers gathered in their respective localities to practice a form of science that served their own understanding of risk and concern for their families, distinguished from the science endorsed by the state. Yet their efforts were considered peripheral to or marginalized by the state's stratagems to normalize radiation risks. Polleri (2019) surveyed three "citizen science" groups,[11] coining the term "conflictual collaboration" to diminish their data practices as "becoming part of the techniques of neoliberal governmentality designed to govern the conduct of populations amid a contaminated environment" (ibid.: 224).

At best, work from these authors reinforced the panoptic character of the state and the incapacitation of citizens; at worst, they represented

[9] In a climate of fear, handheld dosimeters were sold out within days, just as umbrellas were in Tokyo as citizens worried that black rain was about to fall again, decades after the atomic bombing of Hiroshima (Birmingham and McNeill 2012).

[10] For example, it was at this juncture that the MEXT standardized the unit of measurement as Sieverts per hour (Sv/hr) and set the measuring height at the 1m level. Moreover, data transparency was a valued new standard that many advocated; citizens uploaded their data with a range of details such as the type of dosimeter used, the date and time of measurement, the surroundings where the measurement was taken, and other conditions that might influence the readings.

[11] From Polleri's descriptions, I believe LiFu was one of the groups that he had observed.

the data practices of the citizenry as weak versions of science that were eventually ignored or co-opted by the state, downplaying the potential of the more flexible and technology-backed participation that prevailed after the disaster. I saw something different during my fieldwork: I met individuals[12] who used dosimeters to create their own 'monitoring systems' to challenge expert rationality (Jasanoff 2012; Morris-Suzuki 2015), and groups that contended with the state over representations of the fallout, rendering the official science of radiation more temporary and fragile.

Sugiyama-san was also driven to act after the official experts failed to answer his questions. Like most Japanese citizens, Sugiyama-san had been a novice to the dosimeter and its science, yet the salience of that data was the most important lesson he learned when the radioactive plume was precipitated, with the snow, onto his home: "the enemy is invisible". After he decided to return to Iitate, he joined a group of citizens and scientists to form LiFu in 2011. Alongside contending with the legibility of radiation imposed by the state, he and LiFu produced perceptible traces and markings of radiation through their keen awareness of the altered ecologies in Iitate. Their practices produced data that official scientists were not tasked with providing, with the purpose of enabling villagers to thrive again, enlivening their livelihoods by re-connecting them with other organisms, creatures, and landscapes that were as alive as they were.

Before Iitate's reopening in 2017, LiFu organized a series of experiential learning activities and regular weekend visits to bring together people with diverse personal trajectories who sought to retool themselves in the nuclear disaster, a group that eventually assembled in Sugiyama-san's living room: retirees from Japanese multinational corporations, experienced mountaineers, a gardener, a playwright, a self-employed IT professional, university and graduate school students, teachers, a horticulturist, small entrepreneurs, scholars with specializations ranging from high energy physics to social science, and grandmothers who were student activists in the 1960s. They were more than the typical volunteers that we saw in mass media or government propaganda; rather, they became "citizen scientists" who "have gifted technostruggle to the world", as Weston portrayed them (2017: 101), who wanted to challenge Iitate's isolation from the public and the boundaries of safety set forth by the state.[13]

Since 2011, LiFu has experimented with multiple methods of decontaminating Sugiyama-san's rice paddies while preserving nutritious topsoil and monitoring the surrounding environment; they have also explored the cultivation of new crops and alternative ways to regenerate the forest. LiFu engaged villagers and would-be returnees, as well as concerned people more broadly from Japan and overseas, to deploy dosimeters to monitor lingering radiation along major roads and forest trails; they also joined university researchers in collecting samples of air, water, soil, food, crops, and wildlife (such as mushrooms and boars) to study the transference of radioactivity in the local ecology. Differing from the MoE's fixed-point monitoring, LiFu demonstrated a more flexible, thus more creative, use of dosimetric technologies to generate myriad data to accommodate the penetration of radiation and meticulously negotiate the state-enacted safety boundaries. Let me use LiFu's radiation household monitoring survey as an example to

[12] For example, Yoshida-san, the father of two sons from Koriyama city, resisted 'seeing like the state' when he measured the neighbourhood using a Google-map-powered iPad connected to a dosimeter. In contrast to the 1m above-the-ground standard authorized by the state, he measured radiation at just a few centimetres above the ground. He argued that the NRC standard was arbitrary and did not take the health risk to children and pregnant women into account. Fujino-san, one of the very few villagers who refused to evacuate, measured his daily accumulated radiation exposure and posted those readings every day on his Twitter blog, at times criticizing the MoE's leaky decontamination in Iitate. "My body is the evidence of contamination here", he said. These individuals deliberately challenged the borders and boundaries demarcating safety areas legitimized by the state's monitoring infrastructure.

[13] LiFu had an 'arsenal' of dosimeters to forage data for different purposes. The most sophisticated was that borrowed from the High Energy Accelerator Research Organization (KEK), Japan's most renowned research organization for high-energy physics, which was located in Tsukuba (Traweek 1988). Its detector tube could catch random radiation bouncing around in the ambient environment, which could be seen from the readings flickering at 5-second intervals on the display panel. Radiation seemed alive as readings jumped up and down in an unpredictable way. Other portable devices, including wearable and handheld gadgets and GPS-enabled dosimeters, were used for average-over-time readings of ambient radiation.

illustrate how they collaborated with villagers to unlearn the legibility of radiation imposed by the state in order to explore a new persistence of life. Villagers usually participated in this survey before moving back, a time when they felt most uncertain about their livelihoods in a radioactive landscape.

## Household Monitoring Survey and a New Persistence of Life

Residing in Miyauchi hamlet, Miyakawa-san and his wife, Kyoko-san, maintained a family of four and had refurbished their house just before the disaster. At first sight, their house was clean and spacious, as if it were newly built, with a broad view of deserted rice paddies in front and of forest to the rear. Large tree stumps were left on the forested side in the 20m clearance zone, or satoyama, between forest and land that was inhabitable by humans.

Led by Nitta-san, we arrived at their house with two other LiFu members. After a typical Japanese welcome, Nitta-san began explaining household radiation-monitoring procedures to the attentive couple. He also asked to see the floor plan of the two-storey house, its radiation-monitoring records, and those of the surrounding environment. He sketched the floorplan on A4 paper and confirmed its accuracy with Kyoko-san. We then divided into two groups, Nitta-san and I forming one and the others forming the second group, to measure radiation in the house and the surrounding environment, respectively. The second group walked from the door of the house to the rice paddies and the forest, carrying a handheld dosimeter that was connected to a GPS-enabled data logger, while Nitta-san and I started from the centre of the first floor—defined as the reference point for the entire survey—and I pointed the Geiger tube of another dosimeter at the door at 1m above ground level. We measured the living room, the kitchen, and the bathroom, one by one.

Sometimes we saw a noticeably high measurement, for example, rising from a level of 0.2 Sv/hr in a sudden increase to 0.4 Sv/hr (which translated to 3.5m Sv/yr). Nitta-san remained calm but could not hide



his surprise as he tried to find some possible explanations to soothe Kyoko-san, who looked alarmed. “Perhaps it is because the room is close to the forest”, he suggested. He did not comment on whether 0.2 or 0.4 Sv/hr was safe or not, and the MoE’s safety standards were not even mentioned; however, we found more fluctuations in readings both inside and outside their house, revealing that regressions seemed inescapable.

Nitta-san, who joined LiFu in 2013, shared with Kyoko-san what he knew and what could be done according to the experience and knowledge he had gained in conversations and debates among LiFu members. He told Kyoko-san that, according to the MoE’s policy, a second round of decontamination would be conducted only if a hotspot of at least 3 Sv/hr were found. For the relatively high-level radiation that we detected along the side of the house close to the forest, he suggested performing a second decontamination that LiFu had tested in the satoyama surrounding another villager’s house. The conversation was informative and addressed Kyoko-san’s concerns.

The couple was forced to recognize the illegibility of radiation, and re-learn the messy reality that differed from the one promised by the MoE. Nitta-san used the dosimeter deliberately to render those things that were ‘out of place’ (Douglas 1966) as visible as they could be—not only radiation but also the chopped tree stumps, the graveyard, the children’s bedrooms, the forest, a crack near the rainwater drain, the drainage inside the house. His actions and utterances were not fear-mongering tactics, as can often be the case with some anti-nuclear activists (c.f. Zonabend 2007); instead, it was an effort to bring villagers on board with collecting data together to make radiation not only visible but also knowable and actionable, provoking questions about and memories of radiation from the villagers.

This ‘doing science together’ approach stressed the need for participation in the production of knowledge in a time of high uncertainty that was making things complicated and less predictable at the local level (Jasanoff 2012; Kelty 2017). It also convinced the couple to refute the MoE’s restoration masterplan in accordance with which they had been 'put back' into their unevenly decontaminated home. Within the state-enacted borders, there was no assurance that one would have a home that was anything more than temporary and unstable. Thus, LiFu invited villagers to get their hands as dirty as Nitta-san and engage with the illegibility of radiation, which was not inscribed in the maps and charts of the MoE's policy documents and data analysis.

Like many villagers, Miyakawa-san and Kyoko-san were struggling over whether they would restart farming, as many consumers had lost confidence in Fukushima produce. Nitta-san suggested that LiFu could sample the soil in their rice paddies, and shared the findings of experiments that had been undertaken in Sugiyama-san's farmland and greenhouses. Apart from exploring new possibilities for subsistence, we also followed the couple's everyday habits, looking for hotspots that would be most concerning, measuring radiation levels in the warehouse, the nearby graveyard, farmlands, and forests. LiFu's data traced the course of radiation in the messy environment and ecologies of villagers' homes, reflecting everyday life and its vulnerabilities, which MoE officials ignored with their acting-at-a-distance approach (Agrawal 2005; Latour 1987).

Dosimeter readings are inextricably intertwined with villagers' lives and their families in a unique way as the data produced amount to more than technical knowledge. LiFu takes radiation not so much as separable and containable but as relational and penetrating, thereby enlivening data through the collaboration with villagers and scientists to generate localized knowledge about radiation. This is what Ingold depicts as "acts of dwelling", whereby reality emerges from home-related activities and "the specific relational contexts of their practical engagement with their surroundings…. Only because they already dwell there can they think the thoughts they do" (Ingold 2000: 186).

Re-centring life at a returnee's home, LiFu repairs or maintains the web of relations embedded in the very possibility of Iitate's ecology. LiFu's data—essentially many kinds of data regarding radiation risk and safety embedded in the air, soil, food, and freshwater that are vital to life—are being used to enfold the new givens with radiation—black bags, monitoring posts, bodily permeability, and its illegibility—into everyday realities that are embedded in juxtaposition and competition with the state's restoration programs. Data, not the legibility of radiation, become the condition of an animated environment to enliven another form of persistence, a life that I call 'contaminated but safe'.

A home is not merely the sum of a roof, a driveway, satoyama, and farmland, as the MoE seems to have assumed. That agency deploys decontamination and monitoring technologies in an ostensibly organized and uniform manner to build the 'pipes and wires' (Law and Singleton 2013) with which to pull together an environment that has become unruly. LiFu's data prompt temporal moments that question, slow down, and re-orient the intensified rhythm of restoration enacted by these technologies. For many villagers, this homely insight prompts them to opt for local knowledge to establish their boundaries in homes built to be comfortable and persistent as they move on slowly.

From the household monitoring survey, Miyakawa-san and Kyoko-san barely embarked on a new persistence of life, with more challenges to follow. A year after my fieldwork, I returned to Iitate to visit Sugiyama-san. He showed me a new greenhouse and the crops he was growing. He also gave me a gift, a bottle of Japanese sake made from the rice grown in his paddies that had passed the state's food inspection. His father could touch the grass in the garden again as he knew the level of radiation around the house.

## Conclusion

Disasters, as Charles Perrow (1984) notes, have become 'normal events' in the post-industrial era. In Japan, a country historically prone to earthquakes and tsunamis, disaster is both immanent and constitutive of social life and political institutions. Yet a disaster as multiple and unbounded as nuclear fallout has shockingly revealed the neglected embeddedness of technological risks within social, cultural, and political domains, which largely go unnoticed in ordinary times. Official and expert attention alike have focused on pre-disaster techno-political infrastructure and its inadequacy; less attention is paid, however, to the state's efforts to re-inscribe itself through makeshift technologies after the disaster and the disruption it caused, which initially overwhelmed the emergency response instruments and protocols.

I have traced the formation of the legibility of radiation through the dosimeters, maps, and monitoring posts that were assembled to make the techno-political infrastructure more robust and productive. Unlike the high modernist legibility that Scott analysed, such legibility was also achieved through co-production with the spontaneous efforts of the citizenry, who used portable devices and retooled their expertise to detect the fallout and thereby attain a sense of safety in times of uncertainty. 'Seeing like a state' in a digitalized world, therefore, is no longer a top-down or panoptic act as citizens' presence becomes indispensable in data production and representation. Nevertheless, in this case, these contingent interactions and practices also gave the state opportunities to remake itself through the enactment of new boundaries of safety. Yet even the most productive infrastructure cannot compensate for the failure of a '100% safety' promise. When the next human-made disaster happens—whether climate change, wildfires, or a pandemic—the question, then, will not necessarily be about the readiness of the state. Instead, the capacity of citizens will be *the* matter of concern.

The citizens' responses that I have analysed remind us of their capacity to become entangled with the state's representation of a disaster and its remedies. Accessible and affordable technologies rendered the state's boundaries of safety leaky, immanent, and continually renegotiable, empowering ordinary people to enact alternative ways of seeing and perceiving radiation. In Iitate, the notion of 'enlivening' helps us to differentiate these approaches from data produced by the state to show how the environment has re-emerged as an experimental field generative of new relations between villagers' lives and a diversity of things and organisms.

In the Chernobyl accident, affected communities and irradiated bodies lacked the means to initiate their technostruggle to lay claim to



their rights or confront powerful figures and institutions. Dosimeters and maps, following Petryna and Kuchinskaya, are inscription devices whereby dominant and circulable realities are produced in power-laden sites such as hospitals and government bureaus. Yet, when citizens use them to generate their own data, it becomes possible not only to understand a disaster in more than one way but also to create a diversity of collaboration to explore the pursuit of livelihoods that are unthinkable to the state. It is in this sense that disaster becomes productive, because it triggers creativity.

When we push past the incapacitation of victims and move towards an appreciation of spontaneity and creativity at play in making sense of invisible radiation, data begin to look less like something incomprehensible to people and more like a platform that is open even to the least powerful groups. Data also engage experts or scientists who want to become amateurs, as 'scientist-citizens' (Riles 2013; Weston 2017), in times of uncertainty. Citizens' practices have illustrated that data are heterogeneous, messy, and political. Sometimes, they are used to collaborate with the state to fulfil shared goals or interests; at other times, they are used to reject claims or proposals that hinder the protection of citizens' homes.

If we stay close to how data are collected on the ground, the question of returning to normalcy is not always about the remaking of the state and its imposition of an apparently radiation-free future; it can be about the availability and intensity of technologies with which to challenge the very notion of normalcy itself. In Iitate, while not in any standardized or simplified form, data are used to connect a diversity of things and organisms with the returning villagers' livelihoods. As I have shown, the dosimeter articulated traces and markings of radiation in villagers' homes to redefine the boundary of safety in an altered ecology; data enliven an inhabitable environment for villagers who persist in what I call a 'contaminated but safe' life.

It is not my intention to overstate the capacity of ordinary people to respond to a disaster like nuclear fallout. Iitate is also nowhere close to a desirable place for most villagers. Even Sugiyama-san's family was split, with his grandsons moving to another town. Nevertheless, we might take a cue from Iitate about how people tackle big problems by 'doing science together' when they are forced by circumstance to try.

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# Data criticality

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## Abstract

The data moment, we argue, is not a single event, but a multiplicity of encounters that reveal what we call ‘data criticality’. Data criticality draws our attention to those moments of deciding whether and how data will exist, thus rendering data critically relevant to a societal context and imbuing data with ‘liveliness’ and agency. These encounters, we argue, also require our critical engagement. First, we develop and theorize our argument about data criticality. Second, by using predictive policing as an example, we present six moments of data criticality. A description of how data is imagined, generated, stored, selected, processed, and reused invites our reflections about data criticality within a broader range of data practices.

**Keywords**: Data, critique, criticality, predictive policing, digital

## Introduction

Ever more powerfully and in an increasing number of ways, data have become critical in two senses of the word: firstly, by being decisively important for generating, structuring, and carrying knowledge and, thus, key to the generation and sustenance of life as we know it. By their ubiquity and agency in our lives, data have become our ‘companion species’, affecting us in ways that are in part beyond our control (Lupton 2016; Bellanova 2016; based on Haraway 2008). Secondly, data are critical in the sense of being a mirror to society whose essential knowledge they are intended to contain, but to which they are never entirely a simple servant. These two meanings of data converge and intertwine in events and encounters that reveal when digital data become critically relevant to a lived context. Analysing these moments helps us understand how data come into being, how they are worked with and put to work, and how they play their companion-species role(s) in our lives. Thus, these moments in which data become critical to societal life require our critical engagement. This article offers a conceptual and methodical analysis of data criticality, framing what ‘critical data scholarship’ (Lupton 2016) can mean in practice.

In the widest sense data are the foundation of any type of knowledge. This analysis, however, focuses on digital data practices. The fusion of knowledge practices with digital data––the discrete, discontinuous units of information that take the form of binary code––is a key event that gives rise to a broad variety of socio-digital practices that warrant our attention. Moreover, the digitization of data practices implies a crucial qualitative shift in the relationship between data and surveillance that came with the invention of the Internet in the 1960s. The Internet is in its essence a self-surveilling, digital network management machine born out of the organizational need for managing shared data and inseparable from ubiquitous surveillance (Chadwick 2006: 257-287; Zuboff 2019). More than an infrastructure of cables and servers, nodes and connections, the Internet is an ecosystem constituted and sustained through the circulation of digital data as synthesized units of information. Yet, while one constituting function of the Internet is to facilitate the flow of digital data, another is to catalogue, label, direct, and monitor digital data flows. Thus, in its most primordial form, the Internet is a surveillance system that contains and follows data. It is impossible to plug into the internet, let alone participate in the social intercourse of Internet 2.0, without also participating in dataveillance, be it as individual citizen, group, organization, or business.

One data practice that not only derives from, but also inspires new forms of dataveillance is predictive policing, which has gained considerable attention in recent years, although in-depth knowledge about its various data moments is still rare. Furthermore, the concept of criticality has a tendency to mark a political divide in the literature: the embrace of digital data and methods is either seen as critical in rendering police work more efficient and proactive (Ratcliffe 2004; Pearsall 2010), or such data practices are discussed from a critical perspective (Bennet Moses and Chan 2018; Degeling and Berendt 2018). In this paper, we draw attention to the encounters that underline how data become critical to a specific context, while also warranting our critical attention.

Analysis of these moments is based on an interview study conducted by Mareile Kaufmann with experts, police officers, software designers, and ICT engineers on the specifications of seven predictive policing software models with origins in three different continents. The aim of the study was to understand in greater depth how digital data and technologies create new knowledge practices, rationalities, and concepts connected with crime control in a field that has a long-standing history of exercising surveillance, data analysis, and prediction. As in many other domains, digital data and analytic instruments used for predictive policing are embedded in many (non-linear) circuits and intersect with many lives. This encouraged an attempt to trace these circuits and identify moments in which data are rendered critical and require critical engagement. Quotes and insights from this study––marked with fictional first names––are selected to illustrate these moments. It should be noted that data imaginaries, generation, storage, selection, processing, and reuse empirically relate to different aspects of predictive policing, but they also serve as a more generalized catalogue for similar moments in other digital practices and fields. In order to create a framework for these empirical insights and their discussion, we first give more substance to our notion of data criticality.

## Data criticality

Any engagement with data is a critical event. Data produce social and political meaning the instant they are set in a specific context and associated with other data. As noted above, this moment of engagement is 'critical' in two senses: first, in that it implies a moment of decision (ancient Greek: *krinein*), that is, the moment of their affiliation with other data and of a decision or determination of their form of existence. Decisions are made in the moment when data are ascertained in a given context, when they are imagined, generated, collected, stored, recycled, and chosen as a proxy or representation for a phenomenon. Part of an interpretative processing of the world, they are removed



from their logical status as purely given and attached to the contextual elements through which they acquire and transmit meaning. Second, 'data criticality' has a normative meaning due to the political need that springs from the first sense, which is to remain vigilant to the political character of data. The first meaning is the fruit of critical observation, the second describes the sense of the political action.

There are myriad means by which humans and infrastructures coalesce data into meaning, each impacting on the destiny of data in its own way. Thus, these moments also warrant careful reflection about how data is constituted as relevant. If data have become crucial to society to the point of becoming a companion species, this companionship is multi-faceted and follows multiple trajectories, thus requiring a stepwise analytical approach to insights into data's roles in our lives. The concept of data criticality invites our engagement with "the possibilities for critical renewal that everyday companions might suggest" (Austin et al. 2019b: 5). Importantly, then, the purpose of data criticality is not to pass judgement on all data and data practices (cf. Felski 2012); rather, the concept can help us attune to the moments in which data attain meaning and what this means for their––and our own–– situation in the data ecosystem.

In pointing to data's dual criticality, we align ourselves within a history of theories on the relations between data and society: Merton's (1942) CUDOS concept, the empirical program of relativism (Collins 1981), actor network theory (e.g. Latour 1987) marxist and feminist standpoint theories (e.g. Marx, no date: 2nd edition, postface; Hartsock 1983, Harding 1991), agential realism (Barad 2007) have all sought to explain how data can at once be obviously social products yet also represent, be impacted by, and impact upon a world of realities seemingly beyond social determination.

Looking across all these theory categories, we see that data tend to be treated as stable products, an 'immutable mobile' in Latour's (1987) terms, that can carry information intact from one context to another. At the same time, data are also seen as animate in or animated by the precise moment a scientist interacts with them. In this article, we build from the more or less common ground of the theoretical frameworks mentioned above to examine this "liveliness of data" and how it becomes critical in multiple senses (Ruppert et al. 2013: 29; see also Lupton 2015). Contrary to their reputation as technical, binary, and objective information we show that digital data cannot be divorced from the moments that we are describing in this article. How and according to what norms and grammar are digital data assembled? How are they made sense of? Who and what are part of making decisions and interpretations, and of translating data from one context into another? In describing these changes, we provide a catalogue of the different ways in which we can observe the criticality of data and think about data critically. In the following we use the emergent relationships in which data are situated as a starting point for describing how data criticality becomes a core property of the networks that suffuse and surround them.

## Data and moments of meaning-making

While data are constantly dynamic, there are key moments that particularly reveal how they become critical: when they are imagined, generated, stored, selected, processed, discarded, and reused. These moments are at once temporal events and modularizing processes: in these moments, it becomes obvious how data become amenable to being associated, merged, or combined with other data. At each of these encounters, assemblages of designers, scientists, engineers, scholars, professionals, users, and target groups, as well as machines, routines, attitudes, concepts, and preconceptions collaborate in order to render data critical in a specific context or for a particular purpose. These collaborations can be observed over the course of many years and in different environments that are organized around the making and shaping of dataveillance. Using the case of predictive policing as an example, we illustrate data criticality with six moments that serve as inspiration to reflect about data criticality. They portray critical entry points for analysing how other digital practices are also co-constituted



by many actors and involve––maybe similar, maybe different––moments that bring "liveliness" (Ruppert et al. 2013: 29) to data.

### Imagining data

As Evelyn Ruppert (2018) notes, some of the most forceful 'socio-technical imaginaries' (Jasanoff and Kim 2009) we face are those involving digital technologies and data gained via dataveillance. These imaginaries drive and frame many of the critical data infrastructures with which we surround ourselves and on which we base our lives, politics, and decision making. Data feed an imaginary of form, especially within the various fields of prediction; their digital format not only fits but invites continued pattern recognition. The imaginary of digital data as liquid and malleable––we can drown in the 'data deluge' (Bevan 2015), be overtaken by a 'data tsunami' (Rubinstein 2013), fix leaks through 'data plumbing' (Davenport 2014), and even 'sweat data' (Gregg 2015)––proposes their endless re-evaluation for forms and patterns. Digital data encourage the identification of correlative shapes, not necessarily explanations (cf. Striphas 2015; Kaufmann et al. 2019a). This imaginary of data as susceptible to form integrates well with predictive policing, since both mainly work with plausible suggestions about patterns and not why phenomena come into being. Frank, who works on software for predictive policing, confirms this:

> That was what the basic research was all about: to figure out the mathematical structure or phenomena of crime patterns. And when you understand the general structure of that, then you can use that as a basis for a general learning process. … And just to be clear: we're only focused on predicting where and when crime is most likely to occur. We don't predict why or how or who. Those are things that our particular process doesn't focus on.

Digital data do not stand for the idea that all identifiable forms are meaningful. However, in the context of policing, digital data fuel the quest for the pattern that ‘works’. Data imaginaries of liquidity and formability are coupled with ideas about which of these malleable datasets works best to identify meaningful forms. Here, the data imaginaries become more refined. While still understood as yielding practicable and actionable patterns, data imaginaries tie in with methodologies about the right choice of dataset and correlative methods. These include data-opportunistic approaches, such as relating police datasets to any available data, as well as approaches that work with more selective datasets. Chris, for example, who works on prediction models, explains his data imaginary. He correlates police data “with various other statistics, like weather being one, traffic data … basically you use whatever data you have available. It’s very opportunistic. … the number of people buying headache medicine … The more you know, the better system you can make.”

Other imaginaries and approaches include pre-processing to further define patterns of interest. Amanda works on a project developing prediction software for policing purposes. In contrast to the imaginary of ‘big data’, she describes a rather focused and selective data imaginary. Amanda explains how she and her team discussed and tested which data they considered relevant for meaningful predictions, thus also formulating how the teams’ specific imaginary of ‘select data’ unfolded:

> We created an index including socioeconomic status, because there is research that suggests that economically disadvantaged areas are more likely to experience crime than prosperous or affluent areas. … We looked at residential stability and how long people have been living in those neighborhoods, because there is research to suggest that the longer people have lived in an area, the more they are invested in an area, the more attachment they have to that place, and they may be more willing to step in or prevent crime or they have more social capacities to prevent crime from happening in the first place. … We



> looked at linguistic isolation, especially indo-European linguistic isolation. I am not as familiar with that body of research, but I know that immigrant areas––I don’t know about the international scale––but at least in the Unites States, but there is actually less crime in places of immigrant concentration. So that is another variable that we put in. And we also included a race variable, because there is a lot of research specifically in the US, again I’m not sure about the international, about how race is related to crime. There is a whole bunch of research about racial oppression that is driving this relationship. It’s not that the minorities are more criminal than the rest of the population, but there are a lot of structural and macro-level policies that unfortunately even still today are driving crime in minority areas. So we compared all these structural variables with our crime variables and we only selected the variables that had a consistent relationship with all type of crimes. … And we did not include the linguistic isolation and the residential stability, because they were going in the wrong directions sometimes for certain types of crime.

With an eye to more selective datasets, developer Georgios discusses, for example, whether it makes sense to include social media data or not:

> I know that some crime forecasting systems use social media as indicators; we have not used social media in any way and we don’t plan to use it for crime forecasting. I think it’s most valuable to use it for situational awareness––say a bomb goes off––to know what has happened, to get pictures; then it’s super-useful. But I think it’s less useful for prediction. It suffers from some problems, meaning that any time you want to analyse social media data you need a language-processing component … . I

just don't think it makes a lot of sense to use it when we have already a lot of other data that are … less private.

Johannes heads a team that develops a software for predictive policing. Of all the interviewees, he was the most outspoken about the fact that any correlation, any pattern recognition, also needs to include theories about causation, pointing out, "A correlation is not a causality! You can always find a correlation, but when you take a close look, it is not a sensible one … I am not a friend of including just any type of data in software. … Good software builds on knowledge bases. It is based on content, not only pure statistics, mathematics, and algorithms." The type of research which is then quoted as claiming causality in datasets ties in with more complex combinations of theories and dataset imaginaries. Yet an overriding imaginary seems to persist, namely, that digital data are susceptible to mathematical form and that there is such a thing as unbiased data that can reveal meaningful patterns. As IT professional Bertrand states, "If you have … high quality unbiased data for machine learning, I wouldn't rule out that you can have a prediction algorithm that can actually outperform a skilled police officer."

Even at the stage of conceptualizing data we can already observe how they are considered crucial to processes of prediction. This overview of data imaginaries in predictive analytics thus highlights which critique becomes pertinent. While purporting to offer efficiency––a politics of form that can exclude and include notions of causality––the imaginary of malleable, unbiased datasets underlines the necessity of critically describing the theories, correlations, and causalities that are expected to sit in these datasets and that render them critically relevant to the process of prediction.

## Generating data

Data do not exist per se. Rather, someone or something, with or without specific intentions, always generates data. Imagining data and generating them are intertwined processes, as data are often (but not always) produced for a specific purpose. Purpose-driven data generation is informed by ideas about what kinds of data will match a purpose best. Incidental data generation reflects imaginaries in other ways but may introduce purposefulness along with further imaginaries at later steps. Both purposeful and incidental data generation incorporate imaginaries regarding what is true, knowable, acceptable, and complete. The recent activist and scholarly trend of distinguishing between 'good data' (e.g. Mann et al. forthcoming) and 'bad data' (Galdon Clavell 2018) is indicative of reflection about the way in which data imaginaries and data generation speak to each other. In these articles, data are understood to either embrace or disrespect fundamental rights, which implies that datasets can reproduce social in/equalities from the moment of their creation. While discussions about data as 'good' or 'bad' follow specific ethical imaginaries, this article emphasizes more generally that, taken together, moments of imagining and generating data channel the further direction data analyses take, since data are considered critical to explaining or mastering a specific phenomenon.

For example, in the context of predicting crime patterns, the actual generation of data is of high relevance. Any software model that seeks to predict such patterns relies, amongst other things, on data from police reports: incidents that are recorded by the police in a specific geographic area over time. Data from police reports are highly dependent on organizational factors, such as who registers crimes, what forms are used, and where exactly the incidents occur. While variation in self-reporting by victims is already a factor known to influence available data for analyses (not least when it comes to gender difference and intimate partner violence [cf. Chan 2011]), there are many other elements that shape the actual production of data. The interview with police officer Dihyah disclosed that, in his area of responsibility, "approximately 20% of the police population are registering 80% of the information in the database. It's lots of data, but very few register very much." Thus, officers' recording activity also influences the data available for crime prediction. In addition, each officer has a different threshold for deeming an incident worthy of report and, depending on the reporting system, there is also leeway for an officer's interpretation of the reported case, often an implicit aspect of crime data generation. Other administrative elements that affect the generation of data are the level of detail that crime-reporting forms provide and whether they are in digital format or have to be digitized. Software designer Amanda notes that in her own country, "The police department is still using paper forms", which are then digitized. The very translation from analogue into digital forms also influences the kind of data available for analysis. Thus, not only humans, but also their situations, as well as forms and programs are part of producing and shaping the data available for analysis.

When discussing specific information-organizing software for intelligence purposes, Dihyah explains that officers and software designers are well aware of the differences in data generation and related moments of observation. Almost in the spirit of Karen Barad's call for thorough description of the data-producing and recording apparatus (2007), the officers and designers decided to add a field into the software's interface in which the 'story'––that is, the circumstances of data production––is described by the recording officer. Police officer Dihyah explains, "What story are you trying to tell me? You are delivering a lot of data, but where is the story? So they were obliged to fill in a short story. … You have to put it in words. Because we can't really tell that from the data you provided." This context information would then be used to achieve a higher standard of reproducibility and reflexivity in the software.

These examples illustrate how much variation can be found in the preconceptions, routines, and standards for data generation just within the field of policing. Both, human and non-human, intentional and unintentional, reflexive and un-reflexive processes shape the datasets available for analyses of crime patterns and make data act back.

## Storing data

There are no data without a database, without storage or retention (or, at least, only very short-lived data). We have seen that data cannot take shape or meaning without imaginaries of form. Neither can data gather meaning without containment, that is, without limits or borders. Such containers build upon rules of what is contained and what is not. While technological specifications and frameworks for storage come to mind, the digital ecosystem also includes the norms, values, and rules that generate decisions on criteria for inclusion and exclusion in any given database. This is the value-based and regulatory framework of data, which not only orders and structures the borders of the stored data but also the manner of storage (or storage infrastructure), its internal hierarchies, and relations between elements or points. The rules that order databases alter, as a matter of course, the relations of their data to data subjects and much more. While the logic of data storage may not fully determine data and data subjects, we can say that it co-determines the existence of data, the data subjects, processes of handling data, and even the fields that are eventually affected by predictions. The moment of creating and maintaining data storage is key to rendering data critical, especially within predictive policing: the worth of data is established by keeping them and making them available to analysis. As discussed below, the multiplicity and complexity of that moment also needs critical observation.

Within predictive policing we can see that the ways in which data infrastructures and databases are built already have a forceful impact on the data as well as the forms and patterns that data eventually reveal. Software developer Amanda indicates a crucial moment of database-generation that we tend to forget when thinking about digital data analyses, "Officers handwrite when an incident happens, they fill out the paperwork, they submit the paperwork and then it is recorded into database." Building data storage, then, is not only a part-analogue process, but also includes a critical moment of reformatting and translating information. Once digitized, Amanda says, "… you can query the data, you can select a crime incident that you like––which you wouldn't be able to do if you just had stacks of paper forms sitting on your desk. It makes analysing the data much easier and more time-efficient." Even if data storage were at some point to omit analogue infrastructure and procedures of reformatting data, different databases would still be dependent on those who register data into a database, and the rules of storage. To add to this complexity, police officer Dihyah points out that existing rules about databases do not necessarily aid in the process of building a knowledge base. When building a knowledge base, technical and legal rules are interdependent with unstructured decision-making processes. As Dihyah explains,

> We have the law on how to store and how to delete data. We have all this data, all this information, but we don't have procedures, we don't have any systems that further help us in deciding which data to keep, which to delete. This data management is manual. Every time something is registered in the database, someone has to sit and read text. … Every bit of information has to be read and assessed. While quality indicators should be objective, they end up in fact being subjective assessments: How necessary is this? How well can you connect this data with other data, about which criminals, victims? All these assessments about how and why to keep this information are made by people.

While imaginaries of systemic objectivity are still prevalent in the idea of building data storage infrastructure, police officer Dihyah also underlines the need for horizon scans: overviews performed by professionals who then understand how they would like to develop the database further. He also acknowledges how challenging this exercise is when connecting data from different databases for that purpose. Yet, despite acknowledging these difficulties and seeing the complexity of socio-technical collaboration, the imaginary of a unified, objective knowledge base persists. Dihyah says, "We need to know what we know. We need to connect all databases so that we get one answer: this is what we know! Then we can ask [about] what we don't know. … [and] what we need to get … from those who collect information." Equally, in software developer Christian's narrative, the idea of a complete database mingles with the acknowledgement of imperfection, and it is interestingly the human data cleaning process that brings databases closer to perfection. "What's in the dataset? Is it complete? Have they given us everything? We need to first understand whether data needs to be cleaned, we need to understand quality of the data. … There are errors in all databases, you will never find the perfect database."

These examples underline how the making of containers for data storage – technically, via legal rules, and crafted by hand – is shaped by professionalized decisions and visions. These moments of data storage co-determine how and which data are rendered critical and which material data point will eventually be made into a marker of meaningful human experience or behavior.

Data thus pass through a process of imagination, generation, and storage in which each of the socio-technical moments involved co-shapes the criticality of data. Here, the acknowledgement of incompleteness, imperfection, and context meets the ideal of unbiased, complete datasets in curious ways. Initially, data are highly dependent on those who imagine them, those who create and collect them, and the infrastructure they have at hand. Yet the moment of entering them into containers–– storage platforms that follow their own rules and logics––disconnects data to a certain extent from their creators, owners, and collectors. While this disconnect will never be achieved in full, it creates new options for rendering data more malleable, supple, and impressionable.

## Selecting data

As part of most scientific and engineering procedures, data selection takes place before they are subjected to further analyses. What happens here has some similarities with the moment of data generation, but at the stage of data selection differences in modelling the representative quality of data are even more pronounced. After data are generated––for example, by officers filling forms, software capturing data traffic, or sensors receiving impulses––datasets still require engagement and are sometimes even changed as they are selected for analysis. They are 'cleaned' or translated into specific analytic categories. The assessment of data quality and the selection of data for further analyses are tied to specific understandings of the world, of the procedure's purpose, or phenomenon to be analyzed. Sometimes, these cleaning and selection processes can almost become the core of the analytic project. It may take enormous resources to develop a common standard for data selection, to define different data categories, to assign existing data to them, and discard other data. As Sabina Leonelli observes, technology-centric science projects in particular tend to argue over the correct procedures for "data selection, formatting, standardization, and classification, as well as the development of methods for retrieval, analysis, visualization, and quality control" (2016: 16). Some scholars have written manifestos advocating the importance of digital data handling in research projects (Geoff et al. 2011), since not all projects dedicate specific resources to this particular moment.

As the history of the relationship between science and data has illustrated, positions on the selection of data for analysis can vary drastically, something also found in the context of predictive policing. Some designers of predictive policing software, like Georgios, choose to run their analyses on any available data, including public databases on weather, societal events, or phases of the moon. As he observes, "Some cases seemed unusual at first … For example, the phases of the moon. Some of these variables are used for similar kinds of crime. There is no literature about why that is that case, but with full moon you may be seeing more outside." Others, like software designer Johannes and his team, include only highly select data in their analyses, which have been thoroughly examined and curated by policing experts. Unsurprisingly, each approach to data selection ties in with different ideas of data processing, as well as variation in pursued results. Georgios' approach is based on the assumption that data quantity can reveal unexpected patterns, even though explanations for such patterns may not (yet)



exist, as long as large, little-curated datasets still provide the user with a 'correct' result (e.g. a crime in a specific area). Johannes' approach, on the other hand, is informed by specific criminological theories and explanatory models of crime. These include, for example, Routine Activity Approaches or Near Repeat-Modelling (based on Cohen and Felson 1979), whereby the same offender is believed to follow specific routines or geographic patterns, or theories about Situational Crime Prevention (originally Clarke 1997) that suggest crime occurs when targets are inadequately protected. These theories determine the selection of data for analysis. Furthermore, while humans curate most data selection processes, the increasing automation of data selection adds new layers to the process.

Differences in data selection approaches and the––sometimes arduous––procedures of cleaning and organizing data characterize this moment as a central part of data's becoming critical. For example, assigning data to new categories may require their reinterpretation or reorganization, which may question their status as immutable (as suggested by Latour 1987) or always intact. Data can never be scrubbed clean and often they are also difficult to assign to categories––whether because no compromise can be found amongst those who organize and engage with data, or because ambiguous data resist interpretive consensus. When data are cause for debate, it may be argued not only that humans render data critically relevant, but that data also introduce controversy or debate.

## Processing data

Data processing may be the moment that is hardest to comprehend in full since its procedures are increasingly automated. The most common types of data-processing software follow specific analytic parameters and are then trained on datasets to identify patterns of interest. Within these training datasets the 'correct' patterns are known to the engineer so that algorithms and their parameters can be adjusted until the algorithm identifies all the relevant patterns. Once it passes the test of finding the 'correct' patterns, the software is put to use on new datasets, where the correct matches are not yet known. These are so-called discriminating algorithms (cf. Smith and Buechler 1975), although not because they can impact on the right to non-discrimination by being trained on discriminatory datasets, which is also an important debate (see e.g. Benjamin 2019). Technically, discriminating refers to the algorithms' mode of operation, which is based on making distinctions. Other forms of automation are Generative Adversarial Networks (GANs, originally designed by Goodfellow et al. 2014), which create at the same time as they discriminate. GANs still identify patterns in the datasets that they are processing, but they are not trained or given information about what a 'correct' pattern would be. Rather, the algorithm identifies, interprets, expresses, and re-creates what it identifies as 'the essence' of the processed data––without the engineer intervening, determining or even knowing what this essence may be.

Despite the fact that software becomes a prominent actor in the processing moment, data still play a crucial role here. Data are part of determining what, exactly, algorithms are able to identify. Even GANs, which are often presented as independent, creative agents, cannot escape or bypass those moments in which data are imagined, generated, stored, accessed, and selected before being processed. However, during this moment of processing, data and algorithms collaborate in ways that humans cannot necessarily know. This collaborative moment of data processing is also difficult to reconstruct due to the computing powers and processing speed that machines exhibit. In the context of predictive policing software, for example, two interviewees explicate that engineers may define the parameters that they use to program the algorithm, but they cannot know exactly how algorithms combine these parameters when processing data to produce results. Police officer Hans reflected about the effect this has, observing, "I guess it's harder for people, then, to question those patterns if these parameters are not visible or accessible. You just accept the parameters." Thus, data become critical and begin to act not just when humans engage with them, but also when processed by an automated agent.



## Reusing data

At its core, datafication is a problem of recycling (Thylstrup 2019): data is broken down and re-emerges as new data in new contexts. Drawing on related work on recycling, therefore, we finally draw attention to the moment of data reuse and repurposing. Once extracted and selected as suitable for processing, data are repurposed for new and different kinds of uses. Hence, waste metaphors such as 'data exhaust' and 'data traces' have played a significant role in the rise of data practices, with tech companies redefining data flows and digital traces as waste material (Mayer-Schönberger and Cukier 2013). Data analytics companies structure and reuse digital traces to turn them into valuable resources. Such data management, data integration, and data structuring can be understood as the development of data value chains; and it is not only data that are reused. Algorithms also undergo cycles of use and reuse in systems such as facial recognition, biometrics for service provision, and welfare 'decision support' tools. Neither data nor algorithms thus die in digital data ecologies; rather they are recycled: broken down to re-emerge as new matter that enfolds people, times, and places in entirely new contexts. Again, predictive policing tools are a case in point. Despite the practice that each prediction tool is trained on local and very recently produced datasets, the recycling of data is also observable in the original sense of the word: different data points are extracted and 'put together', collected from several databases. Interviewee Christian was an outspoken supporter of combining data from as many different sources as possible. Yet even those who are more selective about their data sources recycle and compose information from different databases. Police officer Dihyah explains that he sees the added value of combining police data with financial information and data from other public databases, not necessarily for predictive policing in the narrow sense, but to assess a person's risk factor:

> [The system] connects all these types of information––financial information and all the other information that we

have in all the other databases¬¬––and then it gives each object a relevance factor based on the rules that impact each object. So, after this automatic process, person A can have a factor of 700 and B can have a factor of 400, telling us that person A could be a bigger risk factor than person B.

This example exhibits a typical effect of recycling. Not only are data originally produced for different purposes and contexts (financial administration, public administration, and police administration), they are reassembled, reused, and repurposed in order to produce new insights. The logic of risk and prevention, originally emerging from the financial and insurance sector, also begins to co-determine policing practices. However, more problematically, since the moments of imagining, generating, storing, selecting, and processing data differ in each dataset, recycling becomes a complex process, in which tracing the histories of datasets becomes a practical and an ethical challenge. The training data used by the National Institute of Standards and Technology (NIST) to develop intelligent facial recognition solutions (NIST 2019) exemplify this. Nikki Stevens, Os Keyes, and Jacqueline Wernimont (2019: online) recently found that the NIST database and training system relied heavily on images of people in vulnerable situations, such as “images of children who have been exploited for child pornography; U.S. visa applicants, especially those from Mexico; and people who have been arrested and are now deceased”, as well as images “drawn from the Department of Homeland Security documentation of travelers boarding aircraft in the U.S. and individuals booked on suspicion of criminal activity” (ibid.).

As the problem of discriminatory datasets is well-known in predictive policing (Browne 2015), recycling data to solve crime problems needs critical attention. This insight is also formulated by programmer and expert Bertrand who says, “History is biased! … They arrest Blacks and all the historical data say, ‘Well, we have all these wonderful arrests of Blacks possessing dope’ … And the algorithm basically says, ‘Sure,



it’s ok, it’s not racist, you can go on [ironically] because algorithms are absolutely apolitical and you can just go on harassing Blacks.’” In his statement, Bertrand denounces procedures of correlating any available data, particularly with police data, that is, software models that heavily cultivate data reuse.

Yet the prediction procedures based on curated datasets also feed the precarious practices of recycling. The more opaque the relations between data subjects, owners, and creators––be it through data storage design, processes of cleaning, or trading datasets––the more difficult it becomes to ‘follow the data’ along its value chains. A classic claim made by those choosing to reuse data is that their datasets are merely “operational” (Grother et al 2019: 18). However, we wish to foreground the point that the data wrought by these datasets remain “sticky” (Ahmed 2004: 90): they cannot be wrested from their agency, sanitized, and presented as new data with no social stains or remains. Rather, they inevitably display the effect of their histories of contact between bodies, objects, and signs. They leave residues, carrying and spreading material, social, and ethical entanglements with critical infrastructures. At worst, such recycling processes can result in the creation of prediction technologies that distribute vulnerability unevenly through sticky associations while simultaneously invisibilizing these ties. Indeed, contemporary efforts to problematize data trajectories also show how data transactions develop haunted data (Blackman 2019). In these cases, data often end up reproducing violence, whether racist, misogynist, or classist. Acknowledging the critical moment of data reuse raises significant questions, then, about the ways in which data are extracted by “documenting humans’ bodies and selves”, while also making them “open to constant repurposing by a range of actors and agencies, often in ways in which the original generators of these data have little or no knowledge” (Lupton 2015: 563). This entanglement affects not only the opportunities of those whose lives remain as residue in data piles, but also everyone else whose data becomes enfolded into these moments. It matters what data are added to a dataset, under what conditions and according to which parameters. The critical moment of data recycling thus warrants pervasive scholarly engagement with the reality and ethics of reuse that counters the imaginary of 'raw' data, and instead examines the sticky trajectories of dataset ecologies (Keyes, Stevens, and Wernimont 2019; Benjamin 2019; Kaufmann et al. 2019a).

## Conclusion

The 'data moment' is not a single moment in time, nor is it a notion descriptive of a 'digital era'. Instead, we have described a recursive, not necessarily linear set of encounters that help us in navigating criticality within today's data ecosystems. Every time data are extracted, selected, stored, processed, and/or recycled a new series of relations and realities is established. This reveals the criticality of data and the need to study data critically. Data criticality draws our attention to the moments when humans and machines choose when, where, and how data will exist and what their agencies will be. The concept responds to Barad's call for describing the circumstances under which data is produced (2007) at the same time as it builds on the observation that data have become our companion species, one that exhibits "liveliness" (Ruppert et al. 2013: 29).

As we have shown in relation to predictive policing, recognizing data as critical to a specific context allows us to see the socio-technical processes of data ecologies. A complex assemblage of agencies, software, forms, regulations, and norms comes together in constantly shifting ways to create data and breathe new life into old data. This generative, creative process can take on animate characteristics. Data is neither sentient nor will-based but, nevertheless, it has agency, conditioning, structuring, and applying pressure on a range of analytic processes. In other words, data criticality reveals that data cannot be rendered exclusively as data. Rather, data are characterized by a radical relationality (Fraser et al 2005: 3), ceaselessly circulating in processes of emerging, breaking down, and reconfiguring. Data are, thus, neither immutable (Latour 1987) nor inanimate. Rather, they are constantly changing and always contingent on the system as a whole. There is agency in our companion species when it interacts with humans and non-humans, when it engages, and is engaged with, in different moments of meaning making. This interaction invites careful, critical observation. Only through critique can we be part of shaping the way our companion species becomes critically relevant in today's society.

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# Data: a cosmopolitical approach

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**DASTS** is the primary academic association for STS in Denmark. Its purpose is to develop the quality and breadth of STS research within Denmark, while generating and developing national and international collaboration.

## Abstract

In this paper, we propose a cosmopolitical approach to, and understanding of, data, based on the work of Isabelle Stengers. This entails appreciating data as constituted through multiple actors and actions, and, accordingly, as something capable of producing unanticipated, surprising consequences. Cosmopolitics helps us think about data, and datafication, as actors in a more-than-human world in ways that transgress a common and widespread perception of data as either neutral, objective and representational or as socially constructed, perspectivist and endowed with human politics. The argument is thus that data and datafication change practices and can bring forth novel layers and qualities of those practices. We explore data through a cosmopolitical approach using two empirical examples generated during 2013-2017, where the authors carried out ethnographic fieldwork in a project on governing and managing healthcare data. We conclude by proposing the term cosmo-data-politics and discuss the implications of this neologism.

**Keywords**: cosmopolitics, data, healthcare, ethnography, actor-network theory.

## Introduction

Data and datafication - practices in which processes, life, and phenomena are turned into data in order to create some sort of value – are associated with great potential and optimism (Mejias & Couldry, 2019). States and government bodies, tech. companies, consulting firms, media and many others all contribute to the prevailing data optimism. At all levels of society––from the individual user of health apps, smart semi-AI applications installed in phones, cars, and the home, to businesses and public organizations, municipalities, regions and nations––data is considered key (McKinsey Global Institute, 2011). It seems that our current moment is one in which everything exists



as data *in potentia*; yet to be datafied matter. Also, for many of us not working with the actual construction of data and algoritms in computer science or in tech corporations, data and datafication are often invisible or ungraspable, and the concrete material practices and circumstances under which processes, objects and relations become datafied, are inherently complex, opaque or secret (Burrell, 2016; Edwards, 2013; O'Neil, 2016; Ruppert et al., 2017; Wang, 2016). Premised by these general assertions about data, we propose an alternative notion of data drawing on the work of Belgian philosopher and science studies scholar, Isabelle Stengers. Based on the field of science and technology studies (STS) and her decades long conversation with Bruno Latour's work, Stengers' cosmopolitics entails that the cosmos (nature) and politics (the social) are inextricably entwined (Stengers, 2010, 2011a). Cosmopolitics implies uncertainty as an ontological condition, which means that it is impossible to definitively settle on what exists and to what consequence. As such, it implies that we should think and act in the presence of this uncertainty and as Stengers suggests "care for the possible" (Stengers, 2011b). The world is an inherently dynamic and surprising place and this must not, and cannot, be ignored (James, 1996a; Whitehead et al., 1978). However, the problem is that it is often, in technoscience as well as in politics, more convenient and common to think of the world in ideal terms as a fully knowable, representable and stable place where science and politics are neatly separated and compartmentalised (Bruno Latour, 1992; Pickering, 1995). On this basis, the article address how cosmopolitics can flesh out moments of datafication and help appreciate these moments as processes of emergence and creation. The article thus proposes and evinces an understanding of data and datafication as something that *adds* to and *transforms* the world in unanticipated ways. An understanding which is in contrast to more dominant ideas about data as representationalist, instrumentalist and reductionist.

The article describes and exemplifies the implications of addressing data cosmopolitically. We do so by, first, presenting and conceptualizing what cosmopolitics entails. Second, we will present the project we followed during 2013-17 about the quality of healthcare data in the Central Region of Denmark. This part consists of a presentation of the project, our research methods and fieldwork, and the analysis of two events in the project. We conclude by discussing the implications of cosmopolitics for understanding data and data politics.

## A symmetrical approach to data

To begin with, we propose that, in general, debates regarding data––both in public and academic life today––often express the view that data is digital, big or comprehensive, as well as of a magnitude that at first makes it seem incomprehensible (Schutt & O'Neil, 2013). Data can thus come in many forms. The very act of identifying and circumscribing something is an act of datafication, or a 'captafication' as Rob Kitchin suggests (Kitchin, 2014). In the first instance, what data is and is capable of, is thus impossible to fully decide or define apriori. This means that for analytic purposes we should be agnostic about the qualities and consequences of data and approach them symmetrically (cf. Callon, 1986).

Popular accounts of data abound, promoting ideas about data as absolute, rational, objective, and accordingly, as key to developing better, more efficient, fairer, more objective etc. practices in business and society at large. These ideas are often promoted by those in the business of selling the idea of being "data-driven" (Chris Anderson, 2008; McKinsey Global Institute, 2011; Science Staff, 2011). These accounts include certain *ontological* assumptions, namely that data are seen as *instruments* for businesses, governance and management, and as *representing* reality, as well as a *means* for improvement and progress. In research and studies of data, these accounts are challenged and elaborated further. It is argued that data require work and sensemaking in order to actually *become* data in the sense promoted by the popular accounts mentioned above (Bossen et al., 2019; boyd & Crawford, 2012; Dourish & Gómez Cruz, 2018; Gitelman, 2013; Wang, 2016). Some of these studies highlight how data has come to play a significant role in all sorts of practices, businesses and governance procedures, in a manner where data has become detrimental to human lives. For instance, take the data practices of predictive policing or insurance services (Eubanks, 2019; O'Neil, 2016) as two examples. What these accounts show, is that profit or allocation of resources oftentimes trump questions of fairness, justice and equality. O'Neil and Eubanks make the important point that the problem in relation to for instance predictive policing or insurance cannot be reduced to a matter of insufficient, incorrect or wrong data. Rather it is a lack of concern and consideration with the consequences of data, and with the particular situations and lives which data influeses, that is problematic. In that respect, the problem, following O'Neil and Eubanks, is exactly what is often considered the quality of data, namely its decontextualized and decontextualizing nature. We consider the work of O'Neil and Eubanks important in understanding the role of data in contemporary society and also that this entails investigating data with *empirical specificity* (Zuiderent-Jerak & Bruun Jensen, 2007). Data considered in general terms leads to general and accordingly limited insights. Therefore, we suggest a focus on specific practices, situations, or moments of data and datafication. In what follows, we focus on how data in specific situations come to play a role that challenges ideas about data as either neutral representations or endowed with human politics based on Stengers' cosmopolitics. The article thereby contributes to further our understanding of data as an unruly actor in more-than-human ontologies. But before we turn to this, we wish to make a few further assertions about data based on an agnostic and symmetrical understanding grounded in actor-network theory.

As we pointed out above data do not transcend practice. Data are products of practice. They are used and made sense of, and made to work in practice, as Tricia Wang, Paul Dourish and Rob Kitchin among others have pointed out (Dourish & Gómez Cruz, 2018; Kitchin, 2014; Wang, 2016). Neither are data monolithic, neutral nor transcendent. Also we want to add an additional point, following from actor-network theory (ANT) and generalized symmetry (Callon, 1986; Bruno Latour, 1987), namely that this is equally so for other types of 'data,' be they narratives or ethnographic accounts. Just as digital data cannot stand alone, but needs to be narrated–– as Dourish puts it––or need thick descriptions, as Wang referring to the work of anthropologist Clifford Geertz, states, it is equally the case with *allegedly* rich, thick and qualitative accounts. We stress this not to suggest that one type of data, say a number, is the same or equal to another type, say an ethnographic narrative. The point is to be agnostic with regards to *any* type of data. Specifically, we think it is crucial to resist this sort of thinking about data, where thick, qualitative narratives are per se considered more extensive than digital data and this is a way of thinking that one might fall prey to, when it is argued that data needs thick accounts. This understanding mirrors the understanding that digital data can indeed now provide the fuller picture, clearly illustrated, and strangely enough, by Bruno Latour and Tommasso Venturini when they argue for the relevance of digital methods in social science:

> Thanks to digital traceability, researchers no longer need to choose between precision and scope in their observations: it is now possible to follow a multitude of interactions and, simultaneously, to distinguish the specific contribution that each one makes to the construction of social phenomena. Born in an era of scarcity, the social sciences are entering an age of abundance. In the face of the richness of these new data, nothing justifies keeping old distinctions. Endowed with a quantity of data comparable to the natural sciences, the social sciences can finally correct their lazy eyes and simultaneously maintain the focus and scope of their observations. (Venturini & Latour, 2010).

In the article, Latour and Venturini thus argue that in "an age of abundance" of data the social sciences can indeed follow and trace the social from the micro to the macro and thus presumably––finally––get a *full picture*, as if this has been the ambition of (all) social sciences all along.



Our point is not to suggest that the above is representative of Latours work, which has, in our opinion been about demonstrating the opposite, namely to problematize ideas about overarching essentialist structures or pre-existing transcendent orders, and accordingly, the ability to be able to produce a full picture (Callon & Latour, 1981; Bruno Latour, 1998, 2005). Our point is instead, that evidently even Latour may slip into a way of thinking about digital data that resembles popular understandings of digital data as potentially providing a full or fuller picture of reality. It is this sort of imagining of a full or fuller picture through data, that we find important to resist because it harbours and promotes a representationalist understanding of data and information. It relates also to the point made by Donna Haraway, Susan Leigh Star and Lucy Suchman, namely the partiality of every perspective. Every narrative is circumscribed, contingent and partial. No narrative, no matter how thick, long or rich, is a full account (Haraway, 1990; Bruno Latour, 1988; Star et al., 1994; L. Suchman, 2002; Lucy Suchman, 2007). We argue, that the above sketched representationalist understandings does not help us in appreciating what Andy Pickering terms a performative understanding of data as something that creates novelty and adds to the world (Pickering, 1995, 2011). Also, and related to refusing ideas about a full or fuller perspective helps remind us that the problem of any data or account is a matter of relation. Our experience of its richness, its adequacy or self-explanatory qualities depends on our specific relation to the data in question (Loukissas, 2019).

The symmetrical approach means that data are different products of different practices with different modes and capacities. If this is the case, as we claim it to be, it also means that we must be able to consider their ontological status as variable and ambiguous and in this regard Isabelle Stengers cosmopolitics is a helpful companion to think with.

## Cosmopolitics

Isabelle Stengers' concept of cosmopolitics entails that we exist in a world in which the cosmos and human life, and how we arrange them (politics), are inherently intertwined, and accordingly we, as human beings, must think, live and act with this as our condition (Stengers, 2000b). One implication of this is that Stengers is critical of both a social constructivist and realist assertion of science. Science is a practice in which scientists are hard at work at creating a situation––an event––in which an entity is made to exist in such a manner that it can be said to exist *autonomously* from the scientist. As an example, Stengers speaks of the neutrino's paradoxical mode of existence:

> [...] the neutrino is as old as the period in which its existence was first demonstrated, that is, *produced in our laboratories*, and [that] it *dates back to the origins of the universe*. It was both constructed and defined as an ingredient in all weak nuclear interactions and, as such, is an integral part of our cosmological models." (Stengers, 2010: 20-21 our italics).

First, it is important to note that this way of thinking about the neutrino seems paradoxical. One might immediately object to the idea that things can be both produced in laboratories and be a cosmological building block of the universe. You cannot have it both ways! But you can and we do, Stengers argues. Her point, borrowing from Latours concept of the factish, is that the world changes dramatically at the moment when the neutrino is produced in a laboratory and also in that respect becomes part of our cosmology. This event becomes consequential for how the universe is theorized and studied from that moment onwards, not to mention how it affects the invention of new technologies inside and outside of the lab (Stengers, 2010). On that basis it makes good sense to acknowledge the moment of production as indeed also a legitimate and relevant part of reality, instead of diminishing or deleting it from our understanding of the world. So the point is that the neutrino is real *and* as old as the universe and the moment in which it was realized through a very concrete, challenging, technological and constructed work process in a laboratory, is equally real. To choose between one or the other version implies a bifurcation of nature, which leaves us with a poorer understanding of reality, not a more objective or correct one (Whitehead, 1920). Cosmopolitics holds that the production and construction of scientific facts make those facts more––not less––real (Jensen, 2004; Latour, Bruno, 2000; Bruno Latour & Stark, 1999). Cosmopolitics thus offers an irreductive way of thinking about science and reality. Science not only discovers and represents what the world consists of, it adds to the world and changes it. But cosmopolitics accordingly also means that how scientists conduct science can and must be scrutinized, which is indeed what Stengers does. When science adds to and not just depicts reality, then what it produces and how, becomes a crucial matter of concern. In that respect, Stengers is full of admiration of science practices that evoke novel qualities of reality based on a passionate interest in what it studies. But for the same reason, Stengers is highly skeptical of scientific practices that, under the banner of science, reduces or molests its objects or in an authoritarian manner claims to hold the only and objective truth about a given subject (Stengers, 2000b, 2000a). Stengers is critical of scientific practices that do not acknowledge that science is indeed a matter of knowledge production and as such always at risk of being wrong or of not having been able to create a situation in which the object of study can articulate itself in a manner that is not prefigured by the researcher (see also Despret, 2004; Despret et al., 2016; B. Latour, 2004).

Cosmopolitics implies that things and objects may be partially existing and that what exist in the world is a continuum of more or less existing objects rather than a matter of binary either/or (Latour, Bruno, 2000). Accordingly, we propose to think of data in a similar manner, namely, as a continuum between being human constructs and detached representations of reality. It seems trivial to point out, since evidently what data *are* at a given moment and place and with which consequences indeed varies dependent upon the circumstances.

We consider cosmopolitics to be a productive concept by which to study data for several reasons. First, it entails seeing data as both a constructed object that requires great effort and work in order to become data, while also acknowledging that data are not simply or only a human construct. This position simultaneously resists the idea that data are 'objective facts' detached from human interests and that data are merely human constructs endowed with "human politics". Second, cosmopolitics suggests that what data produces or may produce, cannot be fully known, but must be curiously and closely investigated. And last, that datafication and data must be made "in the presence" of this uncertainty. What cosmopolitics implies is that data while may be under our control, they do not feel obligated by our human politics, and our datafication projects need to take that uncertainty into account.

In the following, we offer two cosmopolitical accounts of data that came out of an ethnographic fieldwork in the Danish healthcare sector. We consider the accounts to be exemplary of practices in which datafication plays a central role. Both accounts exemplify cosmopolitics, since they are simultaneously about constructing and retrieving data and they show how datafication can have emergent and novel consequences. In this regard we also claim to do empirical philosophy (Gad & Bruun Jensen, 2009; Mol, 2002)

## Field and methods

The authors were invited together, along with other researchers from Aarhus University, to follow and study a project initiated by the Central Region of Denmark. The Region is the governing body for healthcare in the central part of Jutland, Denmark. Denmark is divided into five regions and the central Region is the second largest with approximately 1.3. million people. In 2013, the region proposed a pilot project in which nine different hospital wards were to be exempted from productivity measurement via the established DRG-system (Diagnosis Related Groups). In brief, the DRG system is the one through which the hospitals are reimbursed for the treatment procedures they carry out (Reinhard Busse, 2011) (R. Busse et al., 2013) (Bonde et al., 2018; Bossen et al., 2016). The Region initiated the project "New governance from the patient's perspective". The idea was to measure quality of treatment instead of productivity (number of treatments) and the nine wards



were given full liberty to develop their own criteria and indicators for quality with which they would attempt to govern their wards. Examples of indicators were number of re-admissions of patients (fewer re-admissions indicates good quality of treatment), mortality rates (the lower the better), time from referral from general practitioner to diagnosis and treatment (the shorter the better), patients' satisfaction with treatment, and so on. The overall ambition of the project was to give healthcare professionals the autonomy to decide on the best treatment for their patients, dissociated from economic concerns. The project began in January 2014 and lasted three years. We were asked to follow the project and were offered full freedom to do so in accordance with the methods and theories we preferred (Bonde et al., 2018, 2019).

Our research project was an ethnographic qualitative study. We conducted qualitative interviews and observations aimed at following and understanding the development of indicators and infrastructures, and the concrete changes at the departments as a result of the re-direction of performance measurements towards quality and health benefits for patients. We conducted semi-structured interviews in 2015 and 2016 and did participant observations of meetings and workshops with heads of departments and region officials. Interviews lasted between 60 to 90 minutes. 25 interviews we conducted with head doctors and head nurses from the nine departments; two interviews with the management of a center, to which five departments belonged; and two interviews with staff from the business intelligence (BI) unit responsible for operationalizing indicators. Inspired by grounded theory (Glaser & Strauss, 1967), the interviews were transcribed and coded by means of qualitative software by all three authors. The accounts below are comprised of events that occurred across several departments.

## Partially existing data

In this first example, we detail how the wards, in the beginning of the project, decided upon a range of indicators in an effort to measure and govern quality. However, it quickly became apparent that choosing such indicators was a complicated and demanding process. The idea, central to the overall project, of building a data-driven governance infrastructure based on indicators was thus much more difficult to realize than first assumed. Data existed, but in ambiguous ways in different places and formats. The following account unfolds this and offers a cosmopolitical response.

Denmark is at the forefront of IT infrastructures for healthcare with all citizens having personal id numbers used, amongst other things, for tax, work and health purposes. All five Danish Regions have implemented electronic health record systems (EHR's) that allows for the collection and processing of patient data. In addition, Denmark also has a substantial number of national clinical quality databases, each of which collects and process data about each patient's disease history. This means that there is already many indicators and data on quality of treatment. Additionally, the right to define and select their own quality criteria and indicators only added to this already abundant availability. In total, the nine wards came up with over 100 different indicators. Each ward handpicked those that fit their medical specialization. The idea of having a handful of cross ward general indicators seemed, from early on, unrealistic.

Gathering data on the 100 plus indicators––for instance mortality rate or time from referral to treatment––turned out to require extra work and collaboration amongst clinicians and IT-technicians. Even though the departments had experience with documenting and registering indicators, acquiring new, or re-purposing existing, data proved extensive and challenging. In some instances, existing data from the EHRs could be repurposed and used for the project. This was the case for 57 indicators. However, for the remaining 43 indicators either a lot of work and expertise were required, or data retrieval turned out to be impossible.

Repurposing data from EHRs to support indicators required extensive collaboration between clinicians and the data workers at the business intelligence (BI) unit (See figure 1 below for a simple graphical representation of the central bodies and their relations in the project).



For instance, clinicians at one department had chosen 'non-attending patients' as an indicator and aimed for a 20% reduction of this group in order to increase efficiency. But this required negotiation and discussion between the clinicians and the BI Unit staff. What was needed in this specific case was to decide upon a baseline, and whether the 20% was a decline in absolute numbers (e.g. from 100 to 80 patients) or a decline in percentage points (e.g. a reduction from 10% to 8%). The data-worker at the BI Unit required more information in order to be able to "…tell the data how to behave…". The data-worker had to develop the scripts and algorithms required to process the––in principle––already available data (Interview with data-worker 1, BI Unit). Working out indicators, even with existing data, was dependent upon a dialogue between clinicians and data-workers, since the former were experts on clinical practices, but not on data retrieval, accumulation and analysis.

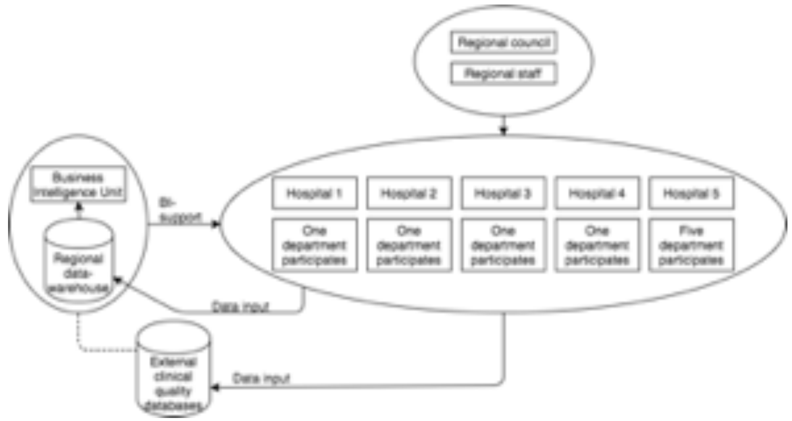


Figure 1. This diagram shows the organizational set-up of the project and the relations to the external bodies relevant to the building of indicators

Acquiring data from national quality databases also required collaboration and clarification between clinicians and data-workers, and in some cases had the additional challenges of limited access to data and incompatibility with the Region's own systems. These national research databases are administered by medical interest groups and act as quality and research repositories for different specialties such as back surgery, head and neck cancer and others.[1] However, the departments that wanted to utilize this data learned that they could only retrieve data on a yearly or half-yearly basis and not continuously as they had imagined, and which was important in order to establish a near to real-time assessment of quality. Second, they found out that data was not easily retrieved, because the data formats of the databases were incompatible with the EHR and the BI Unit's IT systems. Hence, some of these indicators had to be discarded or needed to be established in other ways.

The necessity of interdisciplinary collaboration and limitations arising from existing IT infrastructures also became apparent for the departments that strived to generate data on the 'patient's perspective'. This turned out to involve a lengthy, and to some frustrating, dialogue between the departments and the Region concerning the development of a questionnaire. Agreeing on what the 'patient perspective' entailed and on which questions to ask across diverse patient groups proved challenging. As the head of one department stated:

"We said 'we're in, but you [the Region] have to help us', because you know about this [the patient's perspective]. ...And we have had numerous discussions about who is to measure the patient's perspective. We can't! It is naive to ask a small department to develop such a product, when even the quality unit of the Region cannot accomplish it. We have had six or seven meetings with the quality unit by now..."

In the end though, a questionnaire was developed. But implementing the questionnaire at the departments required the development of techniques for gathering, accumulating and making data from patients accessible. Questionnaire data was gathered either by nurses or Red Cross volunteers at discharge, both of whom required renegotiations of work agreements. Paper questionnaires meant that the response was transcribed and added to a common sheet (analogue or digital). Using tablet PC's alleviated this work, but made data generation vulnerable

[1] The databases in question are Danespine, Dahanca, Thykir, Rhino.



to infrastructural contingencies: network connections were unstable, or login requirements posed difficulties to patients and volunteers. Furthermore, these data were not compatible with the existing standards of the Region's data warehouse and thus required substantial efforts in developing an IT-interface. Thus accumulation, presentation, and distribution of these data could not be automated in ways similar to the other indicators.

In these instances, we see healthcare professionals expressing various degrees of frustrations and surprise with regard to the challenges they encountered with data. We see them work to transfer or produce the data they assumed to be readily at hand. Generating data required extensive work as well as collaboration between clinicians and data workers at the BI-unit, all of which was contingent upon existing data infrastructures. In different ways the people involved in the project, were challenged by the difficulties of realizing data that were presumed to be already available. But the point, from a cosmopolitical perspective, is that the practitioners were not wrong to assume data availability. The problem was that although data preexisted in some form, it still required work, effort and configuration to the particular practices at hand. From a more-than-human ontology that cosmopolitics implies, the example shows that data evades representational and instrumental understandings. It preexists 'out there' and is in some form already available. Cosmopolitics dissolves this perplexity, because indeed data can and do exist *and* require work and configuration. Cosmopolitics thus interferes with predominant ways of thinking about data as either available or not. Consequently, it offers alternative strategies and dispositions towards data projects by equally mitigating a naïve data as "plug'n'play" understanding and the disappointment and frustration that may follow what is become evident that it is not.

In the next account, we show how datafication is productive in surfacing complexity and as such exemplifies another cosmopolitical point, namely datafication as processes of emergence and creation:, data as event.

## Datafication as emergence and creation

One department was concerned with high numbers of surgery cancellations, seeing these as detrimental for the quality of patient experiences. Therefore, they decided to count the number of cancellations in order to decrease them. However, when reviewing cancellations, it turned out that cancellations were not one specific thing. It was necessary to distinguish between four different types, some of which were detrimental to the organization (staff and equipment was idle; other patients waiting were not treated etc.), while others were not (overscheduling), and yet others actually beneficial (a patient was treated earlier than scheduled). This, in turn, led the department to develop procedures for measuring the detrimental cancellations in order to specifically reduce them, and furthermore enabled the department to consider the reasons for cancellations. They wondered why patients scheduled for surgery cancelled or simply stayed away on the day of surgery. This led the department to investigate the problem. They interviewed some patients and discovered that patients that initially had decided to have surgery, sometimes changed their minds, when they had had the time to reflect on and discuss the procedure with their relatives. The department concluded that, ironically the problem was that despite the best of intentions, they provided too swift and efficient a service by immediately (after diagnosis) giving the patients the opportunity to sign up for surgery. Hence, the patients were not given the time to consider the pros and cons of the surgical procedure and then decide whether or not they actually wanted it. The example illustrates how the attempt to manage a specific problem––a high level of cancellations––led first to the attempt to measure the problem and turn it into data as a simple number of daily cancellations; then to a further development and specification of the problem; and finally, to the concern as to whether patients were actually provided the conditions that enabled them to be sufficiently involved in decision-making. This process is evidently a process of emergence. It exemplifies how the attempt to turn a problem into data is interrupted and becomes complicated, leading to both a more specific and targeted data collection, but more importantly to crucial insights about organizational matters––such as patients concerns and reasoning. Ultimately, it could potentially lead to improved quality of treatment and efficiency and resource management.

Another department wanted to reduce the number of re-admissions, which is often taken as a (negative) quality indicator, since re-admissions are often, and for obvious reasons, considered indicative of poor quality treatment. In addition, re-admissions are burdensome for patients and the healthcare system in general. However, the problem in relation to data and performance indicators is how to differentiate between preventable and non-preventable re-admissions? Just counting re-admissions and deciding upon an acceptable rate is not sufficient, because some re-admissions––for example, those that are not due to maltreatment of some sort but to a worsening of the patient's condition for other reasons––are good and should therefore not be counted. So instead, an analysis and evaluation of each re-admission was required. Thus, the ambition to reduce re-admissions began as a matter of just counting them, which was then quickly realized as insufficient and meaningless, because the actual matter of concern was to discern between 'good' and 'bad' re-admissions and this required a much more in-depth analysis.

One last example concerns a department's ambition to have several diagnostic tests planned and performed on the same day, instead of patients having to come to the hospital multiple times. This required defining an indicator for the number of diagnostic tests a patient should receive during a hospital visit. But as a physician noted:

> So, what is the right number of tests per day? Is it ten? Just to suggest a random number. But what if by the eighth test the diagnosis is established? Then of course you should not do the last two tests, just because there is an indicator saying ten. And what if the diagnosis is established after just two tests?

As with re-admission, failing to meet the standard set by the indicator might both indicate negligence and excellence. Deciding upon a standard in order to measure performance, also in this case required further investigation.

In summary, it may be difficult to turn phenomena and concerns into data due to their complicated nature. Although this may be seen as a challenge to ambitions of data-driven healthcare, we wish to stress its value. Our examples show that although data production may be hampered, knowledge production is not. The attempt to produce data may, as we have illustrated here, lead to a more profound understanding of a specific problem and provide an insight into organizational and clinical concerns. Although one might be disappointed that re-admissions, cancellations, and same-day treatment, turn out to be complicated problems to 'datafy', professionals, nonetheless, can gain crucial insights. Datafication can, as these cases illustrate, thus be understood not as detrimental and reductive of real-life matters, but as processes by which these matters emerge, become articulated and ultimately taken care of.

From a cosmopolitical perspective, we would like to point out how the attempt to datafy produces a novel situation in which what is presumed to be relatively simple––countable events, such as cancellations––turns out to be more complicated and in need of reconceptualizations, new taxonomies and accordingly, different actions. We consider this to be a matter of cosmopolitics, not only because it stimulates reflections on the limitations of the very thing that initiated the process, namely datafication, but more importantly because it produces a situation in which something new is learned. Datafication comes to a stop. It is not an all sweeping territorialising event, but becomes concretised and constrained in, and with, the particular practices in which it is intended to be productive.

## Cosmo-data-politics

In this article, we have proposed studying data by way of cosmopolitics. We have argued that cosmopolitics enable us to study and appreciate data and datafication as ambiguous and as both already existing and something to be constructed. Thereby we resist notions of data as either given or as something to be constructed: data are indeed both. Furthermore, cosmopolitics entails the ability to observe and appreciate datafication as processes of emergence and creation, which, in the end, may moderate data ambitions. To help us think about this we propose the term cosmo-data-politics.

Cosmo-data-politics implies that we cannot know what data are capable of, and that they must be studied and analysed with empirical specificity. We have attempted this by providing examples of datafication processes in a hospital setting, and by demonstrating how they can be conceptualized as cosmopolitical. Cosmo-data-politics is about resisting simple assumptions about data, such as that data per se leads to improvement or violence and that it, by definition, is a human construction and instrument. As many other things in a more-than-human world, data and datafication escapes human mastery in various ways and cosmo-data-politics implies that our data projects and our data ambitions must take this into account. We suggest, again referring to Stengers, that we should think of data as a pharmakon (Stengers, 2010). A pharmakon is an agent that in certain doses are poisonous, whereas in others are nurturing and invigorating. Whether it is the one or the other is dependent upon the subject to which it is applied. Following this train of thought, a central cosmo-data-political concern is that the qualities and uses of data must be analysed and evaluated in the presence of those to whom it matters. This may seem a trivial point perhaps, but it nonetheless goes against many of the prevalent ideas about data as detached and decontextualized. In fact, it is exactly detachment, which is often considered a main strength of data. But thinking with the term cosmo-data-politics, we argue that data can be thought of as a type of cosmos. What this entails is that data may, and oftentimes will, come to matter and have consequences beyond the mastery of its human initiators. As such, similar to the term cosmos, they may be indifferent to human politics and intentions. And it is this uncertainty that we as human actors need to take that into account: we do not control the consequences of "our" datafied actions. Consequently, the more data are promoted as detached or universal, the more concerned we should be and the more we should work to bring them into the presence of those they affect. Take, as one example, those who are 'managed' via data, such as the less privileged described by O'Neil and Eubanks (Eubanks, 2019; O'Neil, 2016). But cosmo-data-politics for the same reason also implies a consistent curousity about what data do, a curioustity about what it may do, what kind of surprises and unexpected consequences they may produce. So cosmo-data-politics resists idealist notions of data and is instead about exploring data usage and datafication with a passionate interest in what data do and how and whose existence they potentially transform.

Cosmo-data-politics sees data and datafication as processes that add to the world and *potentially* create learning and novelty, while at the same time resisting data as detached, simple instruments. In other words, cosmo-data-politics entails that data projects are looked upon for their evocative potentials *and* are conducted 'in the presence' of those to whom they come to matter.

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# The rhetorical work of credibility-building for social scientific big data: Positioning arguments and legitimacy in empirical sociology

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## Abstract

This article investigates the rhetorical work of building credibility for social scientific research designs with big data. Big data is discussed as a contested concept in the social sciences, one whose meaning and implications are under dispute. Proceeding from analysis of 29 sociology articles based on empirical research, the author argues that credibility is constructed in this context through the rhetorical positioning of disciplines as legitimate interpreters of big data. The article identifies three distinct positioning strategies: conservative, reformist, and supplementarist, each of which locates the legitimacy of interpretation in its own way. While conservative positioning fixes the locus of legitimate interpretation within the social sciences, those employing a reformist strategy seek to widen it to encompass methods from beyond established social scientific fields. Finally, supplementarist positioning portrays big data as inherently limited and ties the legitimacy of interpretation to alternative approaches. Through identifying and addressing these respective strategies, the article discusses rhetorical positioning as part of the work of enacting big data: a performative process that can foster several visions of the future methodology of the social sciences.

**Keywords**: Big data; Credibility; Rhetorical positioning; Locus of legitimate interpretation; Empirical sociology

## Introduction

Over the past decade, the phenomenon known as 'big data' has received increasing attention in the social sciences (Manovich, 2012; Youtie et al., 2017), most often being characterized as involving high-volume, high-velocity data of varying structure (Kitchin and McArdle, 2016). However, in the social sciences, the notion commonly refers to *digital data* produced in the intertwined processes of digitalization and datafication (Van Dijck, 2014), particularly through human interaction in various digital environments (Lazer and Ratford, 2017). Examples include social media data, Web searches, blog posts, digital administrative records, and digitized texts. The proliferation of these data has inspired much enthusiasm in the social sciences, with big data being heralded as a revolution comparable to the invention of the telescope in astronomy (Watts, 2011: 266).

However, critics have recently argued that, as a phenomenon, big data not only consist of proliferating new data sources, but also involve a prevailing *rhetoric*, which works to rationalize computational methodology (e.g., boyd and Crawford, 2012; Kennedy 2016; Kennedy and Hill, 2018). For instance, Kitchin (2014: 113) proclaims the phenomenon to have given rise to a pervasive discourse that "provides the rationale for adopting new ideas and technologies, and legitimates their development and implementation". The worry is that the legitimating function of big data can privilege those with the resources needed for computational knowledge production while excluding others (Couldry, 2014). On the other hand, it has been argued that the rhetoric surrounding big data is business-driven in nature (Elish and boyd, 2018), while the extent of its influence in other contexts remains unclear. Ultimately, the legitimating function of big data rhetoric should not be taken for granted, particularly in academic research; rather, it constitutes an issue for investigation.

In this article, I examine the concept of big data in the context of the social sciences, where the notion has been caught up in debates pertaining to the future methodology of social research. I draw on a dataset of 29 empirical research articles in sociology to investigate the following research question: how do authors argue for the credibility of their research designs with big data? By 'research design' I mean the overall strategy through which the authors co-ordinate their data collection and methodology for the purposes of tackling their research problems. Focusing on cases wherein the use of big data is problematized, I analyse the set of articles to identify the conceptions of big data they display and how these are used to argue for certain notions related to credible social scientific research.

My theoretical foundation builds on recent work in science and technology studies (STS) by Bartlett et al. (2018), who suggest that key problems with exploiting big data in the social sciences are connected to the difficulty of establishing the legitimacy of a social scientific interpretation of data that were not originally generated for social scientific purposes. Indeed, the *locus of legitimate interpretation* (Collins and Evans, 2007) of big data often seems to reside outside the social sciences altogether. Working with these ideas, I analyse arguments for the credibility of research with big data as attempts at *rhetorically positioning* (Harré and Langenhove, 1998) particular disciplines – for instance, the social sciences or computer science – as legitimate interpreters of big data such that one may credibly draw on their methodological practices. I identify three distinct argumentation strategies, which I term the *conservative*, *reformist*, and *supplementarist* positionings, each of which locates the legitimacy of interpretation in its own specific manner. From this perspective, I argue that the concept of big data serves as an argumentation setting, within which the boundaries of credible social scientific knowledge are negotiated.

My focus on empirical sociology as a case is motivated by recent calls for sociologists to rethink their methodology in the age of big data (e.g., Burrows and Savage, 2014). Without doubt, sociology is not alone as a field in dealing with the problem of incorporating novel data and computational methods (e.g., Grimmer, 2015; Wallach, 2018). However, empirical sociology represents a clear case wherein attempts at building credibility for big data can be expected to be visible. This article presents an analysis of such attempts, and how they are constituted rhetorically via positioning arguments.

I begin by introducing recent methodological debate about big data in the social sciences (Section 2), then move on to discussing my theoretical approach in more detail (Section 3). Against that backdrop, I present my empirical material (Section 4) and analysis (sections 5–8). I conclude the paper by discussing them in relation to critical accounts of big data (Section 9).



## Big data as a contested concept in the social sciences

Previous research into big data as a conceptual phenomenon has emphasized that data always "need to be imagined as data to exist and to function as such" (Gitelman and Jackson, 2013: 3). Under this principle, using certain objects as data involves an act of interpreting them as useful for accomplishing certain analytical purposes (Bowker, 2013; Pentzold and Fischer, 2017: 2). For instance, Puschmann and Burgess (2014: 1691) argue in this vein that the various analytics technologies associated with big data are "still in a period of interpretative flexibility and ongoing contestation over their exact meanings and values" (see also Stevens et al., 2018). These studies demonstrate that, in a given context, big data can encompass a host of conceptions, which compete with each other to be the dominant interpretation of data and methods.

This contestation over the meaning of big data is apparent in the social sciences, where the notion has been associated with both high hopes of epistemic import and scepticism. It has been argued that technologies that generate digital data have a transformative effect on social research, due to both their flexibility and the wealth of data generated (Given, 2006). Digital traces accumulate in near-real time on platforms such as social media, and are thought to yield highly granular information about user activities without researcher intervention (Golder and Macy, 2014). While social scientists have been sceptical about these data supplanting traditional theory-driven methodology (Bowker, 2014; Rouvroy, 2013), they are regarded as important in *augmenting* or *reorienting* research by providing additional sources of information and by inspiring theories about action in novel settings (Edwards et al., 2013).

The enthusiasm notwithstanding, engaging with big data in the social sciences has proved challenging. More than a decade ago, Savage and Burrows (2007; 2009) famously argued that empirical sociology was facing a crisis arising from the field's slow reaction to rapidly proliferating commercial digital data sources and analytics.

Consequently, they implored sociologists to "intervene in the world of Big Data in order to ensure we command a voice in this new terrain" (Burrows and Savage 2014: 5). How exactly this intervention should be accomplished has become a matter of some debate (see, for example, Frade 2016 for a critique). Crucially, as Halavais (2015) argues, the difficulty of bringing big data to bear on social research does not lie in the scale involved, given sociologists' long history of expertise in analysing large datasets from sources such as administrative registers (Beer, 2016; Connelly et al., 2016; Hacking, 1991). Rather, the crux of the issue is that digital data and computational methods are *novel* for social scientists and lack clearly established use practices (Halavais, 2015: 586). For the proponents of big data, the central challenge lies in developing methodology and practices that credibly render them sources of social scientific evidence (Halavais, 2015: 591–592; Halford and Savage, 2017: 1138).

Accomplishing this involves a host of problems. As Halford and Savage (2017) note, sociologists have been profoundly sceptical about the value of big data, arguing that digital traces offer only part of the picture, without providing the contextual information that is vital for evaluating their validity (boyd and Crawford, 2012). Traditional methods such as surveys and interviews are still regarded as the gold standard of data generation (Crompton, 2008; Edwards et al., 2013), while computational methodology is criticized for relying on misguided conceptions of naturally occurring digital traces (Törnberg and Törnberg, 2018). Furthermore, digital data often exist in complex structures, necessitating methods such as machine learning, which lie outside the skill set of most social scientists (Goldberg, 2015; King, 2016; see Salganik, 2017 for work towards developing expertise in these areas). Social scientists are not typically trained in programming, which is an essential skill for critically engaging with the limitations of algorithmic data production and analysis (Gillespie, 2014; Halavais, 2015). One proposed solution is to encourage collaboration with computational scientists and data analysts (Halford and Savage, 2017). However, it remains unclear what form such collaboration should take, not least because differences in methodological paradigms complicate communication between social and computational scientists (McFarland et al., 2016).

These arguments from sceptics resonate with broader criticisms about the role of the digital in social research. As Ruppert and colleagues (2013) argue, digital platforms have the dual role of enabling social activities *while* generating data on them, and therefore their use necessitates a reflexive understanding of this simultaneous process of shaping and tracing action. Indeed, scholars in the digital methods literature (Rogers, 2013; Venturini et al., 2019) argue that researchers interested in the digital should learn to repurpose tools from these environments for social scientific purposes – a process that could involve, for instance, the development of collectively scrutinizable methods that facilitate transparent research processes on proprietary platforms (Venturini and Latour, 2010). However, as Marres (2017) has noted, such critical engagement also means that researchers must refine their methodological traditions so that they consistently mesh well with digital devices such as search engines, social media applications, and software for computational analysis. Ultimately, doing so could lead to reorienting the practices of social research towards increasing inclusion of actors and processes external to the context of academic social science (Marres, 2012).

As this critque indicates, the endeavour to take advantage of big data depends on more than merely building infrastructure for data access. If social scientists are to use big data credibly, they need to articulate how the methodological practices they adopt make sense in relation both to existing practices in their fields and to problems associated with novel data and computational methods. In the discussion that follows, I argue that how this is accomplished hinges on whether the social sciences are conceived of as *legitimate interpreters* of big data. In the next section, I present my theoretical approach for analysing attempts to establish the credibility of big data as positioning arguments.

## Rhetorical positioning and the legitimacy of interpretation of big data

Bartlett et al. (2018) have recently suggested that the notion of the *locus of legitimate interpretation* from the STS literature (Collins and Evans, 2007) offers a way to understand problems with exploiting big data in the social sciences. In particular, they argue that, since most big data in the social sciences are *found data* – data produced "independently of the intent and design of the scientific community doing the analysis" (Bartlett et al., 2018: 4) – the social sciences face difficulties in claiming authority in interpreting them. This situation contrasts with contexts such as physics and biology, in which academic researchers generate their own data, consequently commanding exclusive authority over their interpretation. The locus of legitimate interpretation of big data, or the "location" across distinct expert communities "from which legitimate knowledge claims and judgements of those knowledge claims can be made" (Bartlett et al., 2018: 4), is more diffuse in the social sciences than in physics and biology. And, as the previous section elucidated, in many cases the locus is not only diffuse, but resides altogether outside the social sciences.

This account suggests that attempts to establish the credible use of big data in the social sciences are connected to ideas about *who can legitimately make knowledge claims from those data*. These are conceptions about the *status*, *authority*, and *expertise* of individual disciplines. The credibility of social scientific knowledge production involving big data depends in part on whether the social sciences can be portrayed as the legitimate interpreters of said data. Thus, to exploit big data, social scientists must be able to shift the locus of legitimate interpretation to include their respective expert communities.

Following Collins and Evans (2007: 123–125), such shifts can be understood as attempts to frame data use as legitimate via the allocation of *positions* for actors in a discussion. For example, as Bartlett et al. (2018: 5) document, although bioinformatics is central to data analysis in post-genomic biology, the field is often portrayed as merely performing service work that is subordinate to biology, and consequently regarded as outside of the locus of legitimate interpretation of biological data. Such positioning assigns to scientific disciplines the role of legitimate or illegitimate interpreters of big data, simultaneously shaping what can be considered credible knowledge production. For instance, credible interpretation in biology must involve more than mere computational work; it must also draw on the domain expertise of biologists.

Hence, positioning can be viewed as part of the work of *enacting big data* in the social sciences, where "enactment" refers to the performative work done by scientific practices, research visions, and methodologies in the "making and re-making of scientific disciplines and their knowledge" (Bartlett et al., 2018: 4; see Law and Urry, 2004). Pickering (1995) labelled this performative process the *practice* of science, which consists of creatively building new methodologies, instruments, and theory on the basis of *models* provided by existing scientific culture. From this perspective, positioning can be viewed as a form of boundary work (Gieryn, 1983) or a screening procedure for ascertaining which disciplines should be considered to supply relevant models for establishing new methodological practices.

Although there are various audiences for legitimating work in the social sciences (funders, science journalists, etc.), one crucial audience consists of the social scientific community itself, especially the relevant publication venues. As Harré and Langenhove (1998: 105) have argued, scientific publications can be viewed as rhetorical descriptions of research processes; as such, they "always involve a positioning of the scientists towards a certain audience" for which the processes are made acceptable. I posit that examining *rhetorical positioning* in empirical research articles is important if one wishes to understand how the credibility of social scientific research with big data is argued. Next, I present the empirical material I used to investigate this question.

## Material and method

My study employed a dataset of 29 peer-reviewed English-language articles (see Table 1 and the appendix), downloaded from the Clarivate Analytics Social Sciences Citation Index (SSCI) by means of the Web of Science (WoS) API. The sample was designed to include articles that present empirical analysis of data and explicitly argue for their research designs' credibility by drawing on conceptions of big data. Therefore, the sample is a subset of those empirical articles with a WoS classification as sociology that have big data as their topic.



| Article | Sources of primary data | Argumentation strategy |
|---|---|---|
| Bulger et al. (2015) | Coursera events from meetup.com | B |
| Chen & Yan (2016a) | Digitised literature (Google N-gram) | B |
| Chen & Yan (2016b) | Digitised literature (Google N-gram) | B |
| Gunter & Önder (2016) | Google Analytics Web site traffic | B |
| Heerwig (2016) | Administrative records of financial support to candidates for federal office | B |
| Iannelli & Giglietto (2015) | Twitter, televised talk-show material | B |
| Kahn & Liu (2016) | Administrative data on hotels' energy consumption | B |
| Sachdeva et al. (2017) | Twitter | B |
| Su & Meng (2016) | Administrative records from a governmental discussion forum | B |
| Whang et al. (2017) | Digitised news articles | B |
| Xie et al. (2017) | TripAdvisor hotel reviews and manager responses | B |
| Burrows et al. (2017) | Commercial classification of residential addresses | C |
| Fitzhugh et al. (2016) | Twitter | C |
| McKelvey et al. (2014) | Twitter, census and administrative data on elections | C |
| Murthy (2017) | Twitter, digitised literature | C |
| O'Brien (2016) | Administrative records of citizen requests for city services | C |
| O'Brien et al. (2016) | Administrative records of citizen requests for city services | C |
| Bail (2017) | Twitter, survey data | R |
| Lycarião & dos Santos (2017) | Twitter | R |
| Nardulli et al. (2015) | Digitised news articles | R |
| Ogan & Varol (2017) | Twitter | R |
| Skeggs & Yuill (2016) | Facebook | R |
| Su et al. (2017) | Twitter | R |
| Tangherlini & Leonard (2013) | Digitised literature | R |
| Tinati et al. (2014) | Twitter | R |
| Barratt & Maddox (2016) | Digital ethnography | S |
| Cox (2017) | Semi-structured interviews | S |
| Mendenhall et al. (2017) | Digitised documents | S |
| Stephansen & Couldry (2014) | Participant observation, interviews, Twitter | S |

Table 1: Articles, data sources, and argumentation strategies (B = big data as a change in the conditions of social research; C = conservative positioning; R = reformist positioning; S = supplementarist positioning).

I collected the sample by querying the WoS database for sociology articles that include the term 'big data' in their title, abstract, or keywords. In doing so, I followed the strategy proposed by Beer (2016: Note 1) and used the term 'big data' as an entry point to discussions about the concept. Applying this approach, I conducted an initial search for articles published prior to 2018, which yielded 117 results in total. From this initial set, I excluded non-English-language articles and classified each remaining result as empirical or non-empirical by inspecting article abstracts and, when necessary, the full text. This left me with 50 empirical articles. From these I excluded articles in which data served as the subject of the study. In these cases, big data was discussed as a set of practices to be investigated, and not as a concept guiding research design. That yielded the final sample, consisting of 29 articles. Intercoder testing of this classification procedure with a colleague for a random sample of 50 articles yielded a Cohen's kappa score of 0.72, indicating strong agreement.

Some limitations of this sampling approach should be acknowledged before I discuss the analysis. Firstly, delimiting the sample with the term 'big data' has the advantage of enabling one to explore the various meanings that the articles' authors attached to the notion, without having a fixed definition beforehand. However, this also caused articles that lack explicit use of the term to be left out of analysis (Taylor et al., 2014). Secondly, the SSCI focuses on academic journals and so excludes book-length discussions, conference proceedings, and other empirical work not published in journals; furthermore, it only indexes journals that meet its standards of quality and impact[1]. This narrows the sample to influential journals, and is likely to omit writings published in less institutionalized venues. Finally, at the time of download, the SSCI covered, in all, 129 English-language journals classified as sociology by the WoS[2]. While the list includes most major journals in sociology, it lacks exhaustive coverage of journals that might feature sociologically relevant work on the topic of big data[3]. Neither does it include various possibly relevant journals in fields removed from sociology. For these reasons, the sample should not be taken to be representative of all the various ways of thinking about novel data and methods in sociology or in the social sciences more generally. Rather, it was designed to provide focused evidence of the rhetorical work around big data in a contested context. Speaking to this aim, it provides a rich array of arguments that problematize and build credibility for big data.

To analyse the articles, I coded their full text contents with the Atlas.ti software. Firstly, I identified how the authors conceptualized big data, and how they described the benefits and shortcomings of using particular data and methods to address their research problems. Secondly, focusing on articles that problematize the use of big data, I coded their arguments in terms of credibility of research designs. Here, I focused especially on how particular research areas and relations between them were described and the characteristics that were deemed to constitute good research. The latter codes included desiderata such as comprehensiveness, systematicity, rigour, and sensitivity to context.

Guided by the theoretical framework discussed above, I analysed the coded excerpts qualitatively. Reading through the extracts under each code, I wrote a description of the argumentation strategy adopted in each article. In particular, I identified where the authors fixed the locus of legitimate interpretation of big data and which elements (e.g., theories, analytical tools, and methodological practices) they used to construct their arguments about credible data use.

On the basis of this analysis, I selected for discussion three contrasting argumentation strategies that serve as interesting cases. In the first, *conservative* positioning, credibility is constructed by fixing the locus of legitimate interpretation within the social sciences. In the second, *reformist* positioning, the locus is widened to encompass methods from outside the social sciences. Finally, in the *supplementarist* positioning, the locus of legitimate interpretation of big data is argued to

[1] See https://clarivate.com/webofsciencegroup/solutions/webofscience-ssci/

[2] The search function at https://mjl.clarivate.com/ can be used to inspect lists of journals by category

[3] For instance, the WoS sociology category does not include the journal Big Data & Society or Social Media + Society

be limited, and approaches alternative to big data analysis are portrayed as necessary. While various elements of these three strategies could be identified throughout the sample, they were most clearly distinguished in 18 of the 29 articles (see Table 1). These articles' authors engaged in extensive problematization of big data, arguing at length for credibility. My discussion of the three positioning strategies in sections 6–8 will focus on these articles, but let us begin with a look at the common context within which all the articles discussed big data.

## A change in the conditions of social scientific research

The common starting point in the materials was that recent technological developments, particularly in Internet-based data collection and computational analysis methods, have brought about a *change in the conditions of social scientific research* to which future research practices will have to adapt. The availability of increasingly large volumes of data of new kinds has created *normative pressure f*or utilizing these, which implies a need for methodological development and collaboration:

> The 'big data' revolution has enhanced the ability of scholars to create useful knowledge out of structured data such as ordered numbers and unstructured data such as text or images ... social researchers must find a way to leverage developments in data science if they are to advance social science knowledge and keep pace with other disciplines. (Nardulli et al., 2015: 149)

As this quote demonstrates, the pressure to utilize big data is often associated with the vast potential they offer as sources of information. The articles variously linked the informational potential of big data to large scale, which enables more *comprehensive* and *systematic* analyses, and to the data containing information that is at the same time *macroscopic* and *detailed* while also capturing *longitudinal* patterns. The authors claimed that, produced in digital settings, big data can provide evidence of *naturally occurring* behaviour, that is, 'information on what people do and say "in the wild", rather than what they say they do in interviews and surveys' (Tinati et al., 2014: 664). For the same reason, the data were characterized as affording entirely new information about processes that are themselves new, such as hybrid use of social media and traditional communication technologies (Iannelli and Giglietto, 2015), or processes that were difficult to observe previously, such as macro-scale word-use patterns in historical literature (Chen and Yan, 2016a).

These properties of big data were variously associated with digital administrative records, social media data, digitized news and literature, and Web-site traffic data. Importantly, the change brought about by big data was often explicated not in terms of just one attractive feature but, rather, as a combination of many factors – such as increased detail and large volume – which together enable granular comparisons between cases at a comprehensive scale. These novelties were typically described in terms of comparison with more traditional methods. Therefore, what was deemed to constitute big data was contingent on the methodological context of discussion in the given domain. This is in accordance with the working definition of big data proposed by Taylor et al. (2014: 1) for the social sciences, according to which "there is a step change in the scale and scope of the sources and materials" available with respect to certain objects of interest.

While authors anchored their adoption of big data through an appeal to the data sources' attractive properties, pressures to engage in methodological development and collaboration were identified in connection with several problems, such as the data's complexity or overwhelming volume. On a related note, traditional data-generation and analysis methods developed for small-scale settings were argued to be incapable of successfully harnessing the scale and other beneficial properties of large digital datasets.

As noted above, the articles varied in the extent to which they problematized big data. Explicit arguments to support the credibility of research designs were found largely in connection with arguments for rethinking methodology or engaging in novel collaborative relationships. In the sections below, I focus on those articles featuring extensive problematization of big data, because this is where arguments for establishing credibility were most clearly visible. With the first argumentative strategy I discuss, scholars sought to establish credibility by fixing the locus of legitimate interpretation within the social sciences.

## Conservative positioning: Giving meaning with established theory

Several of the articles portrayed the found nature of big data as presenting the social sciences with a dilemma. On the one hand, the data were argued to contain information about social processes that have proved difficult to study; on the other, the data have not been produced in line with rigorous protocols designed for research purposes. Hence, they frequently contain large volumes of irrelevant detail, lack clear structure, and display potential for unknown biases. This constitutes an impediment for exploiting big data in social research. For instance, addressing geodemographic data, Burrows and colleagues argued:

> The statistical procedures that each [commercial system] uses to cluster and then classify each address are proprietary and this is one of the main reasons why such systems have sometimes not proved popular with academics. Not only that but the veracity of the classifications are not primarily driven by social scientific sensibilities; they 'work' only in the sense that they ... have proven 'useful' to a wide range of commercial, public sector, and political bodies. (Burrows et al., 2017: 191)

Here, establishing a link to existing social scientific practice is



emphasized as important for credible interpretation. In addition to geodemographic data, this idea was present in connection with, variously, digital administrative data (O'Brien, 2016; O'Brien et al., 2016), Twitter discussion data (Fitzhugh et al., 2014; McKelvey et al., 2014), and Twitter in combination with digitized texts (Murthy, 2017). While some authors described Twitter data as already well-established in the social sciences, it was argued that current uses lack theoretical underpinnings (McKelvey et al., 2014; Murthy, 2017). Well-developed theoretical understanding was considered crucial for the analysis of big data, and purportedly theory-free approaches to pattern discovery were criticized (e.g., Murthy, 2017: 18; O'Brien et al., 2017: 140). A lack of face value meaning of big data impelled researchers to tie their research designs to the 'fundamental understanding' provided by established theories. Failure to do so was argued to be dangerous:

> The challenges of detecting signals of social phenomena in the online environment implore us to develop a fundamental understanding of the social phenomena we intend to detect. Failure to understand the social processes underlying activity observed at large scale is dangerous and may lead to misleading or spurious results. (Fitzhugh et al., 2016: 138)

A strategy frequently employed in these articles to establish credibility consisted of *theoretically structuring the data* to make them interpretable in terms of already familiar methodology. In this context, 'theory' amounts to an organizing conceptual framework emerging from previous social scientific research. Theory in this sense was drawn upon for diverse objectives: to distinguish between relevant and irrelevant data, to identify some parts of the dataset as informing about important social scientific concepts and phenomena, and to validate new sorts of data against trusted sources.

For instance, McKelvey et al. (2014) argued that understanding how use practices on Twitter differ is necessary for exploiting the associated data to study offline political phenomena, such as candidates' performance in elections. To develop such an understanding, they referred to political science's theory of issue publics, which implies that electoral performance should correlate positively with the attention a candidate receives from Twitter users who ordinarily do not discuss politics. They found support for this hypothesis by identifying multiple Twitter publics through content analysis and estimating correlations between discussion volumes and the candidates' performance. In another case, O'Brien et al. (2016) drew on the 'broken windows' theory in urban sociology to identify known types of civil disorder from digital administrative data about citizen requests for city services. The authors then used factor analysis techniques to identify the dimensions of these data and to construct metrics, which they validated statistically against audit-based measurements of disorder, alongside census and survey data. Finally, Fitzhugh et al. (2016) drew on the communication theory of 'rumouring' to identify disaster-related messages on Twitter. They argued that, while algorithmic methods for signal detection are not new to social research, their application to messy social media data is problematic. Rumouring theory gave the authors criteria for filtering the data to help them increase the signal strength of disaster-related messages and interpret the results as genuinely measuring disaster communication.

These examples show that big data research following this strategy can include traditional methods for drawing statistical inferences and describing the data (Burrows et al., 2017; McKelvey et al., 2014; O'Brien, 2016; O'Brien et al., 2016), but also methods such as algorithmic signal detection (Fitzhugh et al., 2017) or keyword searches of Twitter and literary material (Murthy, 2017). The key point here is that the methods should have tried-and-true uses in the fields where they are applied and that one can make them applicable by moulding unfamiliar data in line with established theory. Once this procedure of "translating" (O'Brien et al., 2016: 114) big data to familiar methodology is completed, the information contained within may be unlocked.

Importantly, it should be noted that this emphasis on traditional methodology does not preclude joint efforts of the social sciences and other fields:

> [S]cholars should develop a systematic theory of how online discourse is related to offline discourse ... Such a theory, and the measurements it yields, would link informatics with allied social science fields such as sociology, political science, health, and economics. (McKelvey et al., 2014: 448)

While 'allied' fields such as informatics could provide the social sciences with an understanding of the techniques by which digital data are generated, interpreting what those data mean was presented as a matter to be articulated in terms of social scientific methodology: a credible interpretation of big data cannot be established without resorting to theory as a tool for organizing and giving meaning, because in isolation from social scientific methodology, the data *do not have a meaningful interpretation*. In this view, the locus of legitimate interpretation resides within the social sciences. Accordingly, the relevant articles positioned areas within the social scientific domain as possessing rigorous methodological protocols that can ensure the credible use of big data sources. This *conservative positioning* strategy is an effort to maintain the authority to legitimately make claims about big data within the social sciences. Simultaneously, a boundary was drawn between fields positioned as manifesting rigour, and alternative methodologies lying beyond the newly established locus of legitimacy:

> [Big data] must be demonstrated to be both reliable and valid in their measurement before modeling can begin, which unfortunately seems to be the default in many current approaches that emphasize 'econometrics' over 'ecometrics' or simply the power to predict. However powerful predictive analytics may be, it does not answer the substantive questions about social processes and

> mechanisms that motivate most social scientists. (O'Brien et al., 2016: 139)

In this extract, positioning is used to limit the locus of legitimate interpretation so that only certain methodological practices within the social sciences can be considered credible. This offers a contrast with the argumentation pattern discussed in the next section, wherein incorporating computational tools from outside is portrayed as necessary for credibly analysing big data in the social sciences.

## Reformist positioning: Mediating with computational tools

A prevalent problem wrestled with in the materials involved the incapability of existing social scientific methodology to encompass digital data adequately. The shared feature behind these articles was that they were dealing with data that have a textual component, such as social media discussions (Bail, 2017; Ogan and Varol, 2017; Su et al., 2017; Tinati et al., 2014), news articles (Nardulli et al., 2015), or digitized literature (Tangherlini and Leonard, 2013). While standard methods of content analysis and close reading were regarded as the gold standard in terms of validity, applying them reliably to large volumes of text data was claimed to be impossible:

> Achieving high reliability in human-coded content analysis is often challenging, especially when analyzing large volumes of data, as it increases the likelihood that coders will make mistakes ... [W]hen relying on the subjective judgments of human coders, achieving perfect reliability is almost impossible. (Su et al., 2017: 408)

A related problem stems from social media data's lack of contextual and demographic details (Bail, 2017). When combined with the brevity of social media messages, the lack of contextual information was argued to make interpretation difficult even for methods with established validity (Ogan & Varol, 2017: 1224–1225).

Standard automated methods for analysing text content and network structure, while capable of reliably analysing data in large volumes, were argued to be incapable of grasping contextual nuances of meaning (Su et al., 2017: 409–411). One proposed solution for the problem of data volume was randomized sampling (Lycarião & Dos Santos, 2017: 378–379). However, others argued that sampling big data can, in extreme cases, distort the information held by the data:

> Big Data has commonly been approached with small-scale content analysis ... or larger scale random or purposive samples of tweets. Rendering Big Data manageable in this way overrides its nature as 'big' data, bypassing the scale of the data for its availability or imposing an external structure by sampling users or tweets according to a priori criteria, external to the data themselves. (Tinati et al., 2014: 665)

A more general problem raised has its roots in the proprietary nature of many digital datasets. In particular, the authors emphasized the artificiality of social media data, arguing that ready-made tools provided by platforms such as Facebook yield unreliable, black box representations of social media networks (Skeggs and Yuill, 2016). A large proportion of social media data were noted to be private and impossible to access via platform-provided tools (Bail, 2017). While Twitter was recognized as exceptional in its openness, even Twitter discussion data were argued to be artificial, being shaped by platform design (Tinati et al., 2014).

Thus, in this argumentation strategy, standard social scientific methods and the ready-made tools from digital platforms were portrayed as *incapable of accessing* the information contained in big data. The commonly adopted solution was to *extend the available methodology* and tools with methods imported from other disciplines, most notably data science or computer science. In this vein, Bail (2017) introduced a Facebook application that facilitates obtaining users' consent to access private data, and supplements these with surveys to provide additional contextual information. Likewise, Skeggs and Yuill (2016) developed a browser plugin that tracks how Facebook monitors users elsewhere on the Internet. Another example is Nardulli et al.'s (2015) machine learning approach that combines context-sensitive human coding with scalable automated text classification to generate rich large-scale datasets from news articles. Finally, Tinati and colleagues (2014) introduced a software tool that draws together network metrics and visualizations into a dynamic workflow for alternating between large-scale representations and in-depth qualitative analyses of Twitter networks.

These examples highlight the difference between this argumentation strategy and the conservative positioning discussed in the previous section. Rather than rendering big data amenable to analysis via familiar methods, the authors in this strategy stressed that the information in digital data cannot be exploited adequately without importing or developing methods that are novel for the social sciences. The aim behind this *reformist positioning* is to extend and configure social scientific methodology to enable more flexible analysis of digital data, and to provide data access in cases of restrictions imposed by the material's proprietary nature.

In this regard, it is important to recognise this view's similarity to that expressed in the digital methods literature (Venturini et al., 2019). The twofold challenge of adapting digital tools to social scientific purposes and simultaneously retaining sufficient openness and control over the research processes also underlies the reformist positioning. Crucially, as digital methods scholars emphasize (Venturini et al., 2015), in many cases answering this challenge implies that social scientists should enter into collaboration with other disciplines. Likewise, in my sample, the success of reforms to social scientific methodology was deemed to depend on collaboration, because of the technical expertize and



infrastructure required:

> [W]e believe that the most propitious path forward is to create collaborations between social scientists and data scientists. It is through such collaborations that social scientists will be able to capitalize on data science techniques while retaining the nuance needed for studying complex social phenomena. (Nardulli et al., 2015: 177)

This quote illustrates two points. It demonstrates that when credible models of methodological practice are found to be lacking in the social sciences, the locus of legitimate interpretation starts to become diffuse. However, it also makes it clear that the legitimacy of interpretation is extended beyond social science *only to the extent required to enable the application of nuanced social scientific methodology.* In the materials, computer science and data science were generally portrayed as emerging fields that, although developing rapidly, cannot independently solve the problems of interpreting textual meanings in large datasets. Social scientific theory was argued to be essential for interpreting the meaning of big data yet insufficient without methodological reform:

> [S]ociological concepts, theories and methods are critical to Big Data analysis ... the meaning of these data is not self-evident but requires robust methodologies, nuanced conceptual vocabularies and theoretical frameworks drawn inter alia from sociology. However, the existing sociological repertoire of methods ... will not be sufficient in this endeavour. (Tinati et al., 2014: 678)

In the reformist position, computational methods come to play a crucial *mediating* role between social scientific methodology and big data, enabling the application of sophisticated social scientific perspectives to big data, while retaining the information they contain. Accordingly, credible uses of big data demand hybrid methodology, which can scale social scientific expertise to be responsive to the information inherent in big data.

## Supplementarist positioning: Counterbalancing big data

The previous two sections focused on attempts at establishing the credibility of taking advantage of big data in the social sciences. This section demonstrates that the notion can also be used to argue for alternative research designs.

The starting point in this strategy was a characterization of big data as an established research agenda in the social sciences, yet one unable to answer important social scientific questions. Big data approaches were portrayed as large-scale quantitative analyses of online communication, such as network analyses or quantitative measurements of macro-scale discussion dynamics (Barratt and Maddox, 2016; Cox, 2017; Stephansen and Couldry, 2014). These approaches were presented as holding appeal in that they "map out large-scale communication patterns and network structures" (Stephansen and Couldry, 2014: 1215), and enable *unobtrusive observation* of behaviour in settings that are otherwise difficult to access, such as stigmatized online populations (Barratt and Maddox, 2016).

The main criticism of big data was that large-scale analyses of digital traces lose nuances of the context of production. Big data approaches were argued to be based on problematic assumptions, and the artificial nature of digital data was emphasized:

> Claims about large-scale quantitative analyses of digital traces … being more 'complete' or less 'biased' than surveys or interviews are premised on assumptions that native digital data objects are produced, stored and analysed 'objectively', yet researchers must choose what to select and what to store and often must rely on 'black box' media analysis tools, built by and for corporate interests … Furthermore, the meaning of the data may be lost or misinterpreted when taken out of the social and cultural context within which it was produced … This critique … suggests that there are limits to what researchers can expect from these new digital artefacts of social behaviour, both in terms of interpretation and representativeness. (Barratt and Maddox, 2016: 702)

Similar criticisms are present in the other two positionings; however, in those strategies the stated aim is to overcome these problems, whether by introducing computational tools, or by establishing methodological protocols that anchor interpretations of big data to theory. In contrast, in the articles at hand, the argumentation strategy was to align oneself with alternative approaches seen as a *counterbalance* to big data.

Along these lines, Stephansen and Couldry (2014: 1224) argued that an ethnographically and hermeneutically oriented 'small data' approach is necessary for understanding the 'micro-processes' of community-formation on Twitter. Barratt and Maddox (2016: 715), on the other hand, argued that the interaction with research subjects in digital ethnography is uniquely able to provide researchers with the contextual information needed for understanding "key community issues, like the tensions between publicity and secrecy".

The argument in this *supplementarist positioning* is that there *are bounds to the legitimate interpretation of big data in the social sciences.* With respect to certain knowledge claims, it does not matter whether computational tools are imported or the methodology is modelled on established protocols. Certain information simply cannot be accessed within a big data approach:

> While quantitative metrics can provide important insights into the form that online communities might take and the extent of their interactions, an ethnographic and hermeneutic approach is needed to understand how

> Twitter and other digital platforms become embedded within particular contexts and used by social agents for their own purposes. (Stephansen and Couldry, 2014: 1224)

This argument is premised on positioning big data research as an established branch of the social sciences, one that focuses on large-scale quantitative analysis of macro patterns in digital trace data. Big data cannot be legitimately used to address certain epistemic interests because the approach consists of large-scale unobtrusive analyses of macro structures, which by definition cannot access context-sensitive information. Here we see an instance of boundary work between big data approaches and alternative perspectives, wherein engagement with the alternatives is motivated by a portrayal of big data as an established yet epistemically limited agenda.

Importantly, the authors did not advocate rejecting big data approaches outright, but rather described them as "undoubtedly useful" (Stephansen and Couldry, 2014: 1215). The upshot is that big data analysis should be *supplemented* with context-sensitive information produced by in-depth studies, "with which we can better interpret the findings of studies based solely on the analyses of their digital traces" (Barratt and Maddox, 2016: 715). Thus, alternative approaches are able to carve out a position for themselves next to the established big data agenda, gaining support by appealing to the epistemic promise of large-scale digital data.

## Concluding discussion: Enacting big data via positioning rhetoric

I have argued above that in empirical social scientific research, arguments for the credibility of research designs involving big data are shaped by the rhetorical positioning of research areas. Given conceptions of the problematic yet promising properties of big data, positioning rhetoric works to establish their locus of legitimate interpretation. How this is accomplished depends on whether the social scientific methodological practice – that is, the theories, methods, and data that are already familiar to social scientists – can be portrayed as providing readily applicable models for utilizing big data. When successful, as in the conservative positioning, the legitimacy of interpretation can be located within the social sciences, and credibility argued for by drawing on traditional methodological protocols that tie interpretation of the data to theory. Otherwise, the locus must either be widened, as the reformist position argues (to enable methodological imports from other fields), or limited, as those taking the supplemetarist position maintain (to argue for alternative approaches).

The account fleshed out above speaks interestingly to themes discussed in previous literature. Rhetorical positioning in empirical publications can be understood as part of the performative process of *enacting* big data in the social sciences (Bartlett et al., 2018). As scholars of the rhetoric of science have argued, the procedure of review and revision of scientific articles can be seen as negotiation of the status assigned to their claims by the relevant scientific community (Myers, 1985). Hence, the positioning of disciplines as legitimate interpreters of big data in empirical articles can be taken to reflect the process of constructing the boundaries within which credible social scientific knowledge claims can be made. In this light, conceptions of big data in the social sciences constitute an argumentation setting for enacting particular kinds of knowledge production. This is consistent with the idea put forward by McFarland et al. (2016) that big data represents an opportunity for establishing novel collaborative relations between the social sciences and computational disciplines. Positioning is a process that contributes to determining whether or not this negotiation can lead to the creation of a productive 'trading zone' (Collins et al., 2007; Galison, 1997), where "researchers from entirely different paradigms, despite differences in language and culture, collaborate with each other to exchange tools, information, and knowledge" (McFarland et al., 2016: 13).

In the critical literature, such hopes have been dampened by arguments that the hype-inflated rhetoric surrounding big data can create unbalanced power structures by rationalizing computational forms of knowledge production (Couldry, 2014; Elish and boyd, 2018; Kitchin, 2014). Worries about such a *digital divide* (boyd and Crawford, 2012) emerging between the social sciences and computational approaches have spurred methodological debate among social scientists, lending weight to attempts to incorporate novel data into social scientific methodology. This leads us to the question of how this incorporation is negotiated, and what kinds of social scientific knowledge production are simultaneously enacted.

Taken in its entirety, my analysis provides a balanced view of the rhetorical work around big data in the social sciences. While big data approaches were met with enthusiasm overall, critical conceptions were frequently articulated to counter their attractive properties. Moreover, this interplay between problematic and promising facets was what ultimately constituted the thrust for both methodological reform and adherence to established social scientific practice. Importantly, conceptions of big data were used to bolster arguments both in favour of the use of said data and those favouring alternative approaches, depending on how the associated disciplines were positioned. That said, given that the sample examined in my study was not representative, one should not consider this analysis to provide evidence of the prevalence of each argumentation pattern discussed. Research seeking such evidence would be worthwhile, however, and similar work is already being carried out in other contexts (Stevens et al., 2018).

That the positionings discussed above work to enact different kinds of knowledge production is evident when, for instance, one considers their diverging takes on the proprietary nature of digital data – in particular, with regard to the recent data-access limitations imposed on social media platforms (see Schroepfer, 2018). Whereas the conservative response to access restrictions would be to draw on those sources of big data still accessible via traditional methods, the reformist would respond by re-configuring social scientific methodology to improve access possibilities. In contrast, the supplementarist strategy would be to mount a critique of such data by pointing to their proprietary nature and emphasizing the need for in-depth studies. In each case, data-access limitations are cited in support of different visions of what the future methodology of social research might look like.

However, it is also important to note that these positionings might not conflict with each other in any strong sense. Instead, different rhetorical strategies are likely to be suitable for different purposes. For instance, it may be that reformist positioning is effective for credibility-building with large unstructured sets of textual data while the conservative strategy works for data more familiar to social scientists, such as digital administrative records. Indeed, the account proposed here points to an unanswered question that calls for future empirical work: what determines which disciplines and methodological practices are positioned as legitimate in enacting big data? Pickering (1995) has argued that the elements employed in creatively constructing novel scientific practices are selected as part of a somewhat indeterminate real-time process of discovery. Comprehensive enquiry examining the conceptions that guide positioning in different contexts wherein big data are enacted could provide insights into how this creative process of repurposing and discovery works.

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